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PART III

ENVIRONMENTAL PROTECTION AGENCY

■

HEAVY-DUTY ENGINES FOR 1979 AND LATER MODEL YEARS

Certification and Test Procedures

Title 40—Protection of Environment

CHAPTER I—ENVIRONMENTAL PROTECTION AGENCY

[FRL 767-7]

PART 86—CONTROL OF AIR POLLUTION FROM NEW MOTOR VEHICLES AND MOTOR VEHICLE ENGINES: CERTIFICATION AND TEST PROCEDURES

Certification and Test Procedures for Heavy-Duty Engines for 1979 and Later Model Years

AGENCY: Environmental Protection Agency.

ACTION: Final rule.

SUMMARY: This rule prescribes more stringent gaseous emission standards for heavy-duty gasoline-fueled and Diesel engines for the 1979 and later model years, and revises parts of the current instrument requirements and test procedures. Although there have been gains in control of air pollution, there are many air quality control regions which will not be able to meet ambient air quality standards with currently implemented control strategies. Heavy-duty vehicles contribute a significant percentage of the total hydrocarbons (HC), carbon monoxide (CO), and oxides of nitrogen (No_x) in the air. This regulatory action will result in significant reductions in gaseous emissions from heavy-duty vehicles.

This action is forecast to result in a reduction by 1990 in nationwide emissions of .18 to .30 million tons of HC, up to .80 million tons of CO, and .12 to .22 million tons of NO_x. These reductions correspond to urban air quality improvements of 2 to 5 percent for oxidants, 1 percent for carbon monoxide and 1 to 2 percent for nitrogen dioxide.

EFFECTIVE DATE: October 18, 1977.

FOR FURTHER INFORMATION CONTACT:

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SUPPLEMENTARY INFORMATION: The Environmental Protection Agency (EPA) published a Notice of Proposed Rulemaking (NPRM) on May 24, 1976, proposing to revise the heavy-duty engine (HDE) emission regulations for 1979 and later model years (41 FR 21292). EPA proposed to lower the current gaseous emission standards of 16 grams/brake horsepower-hour[1] (g/BHP-hr) hydrocarbons plus oxides of nitrogen (HC $+NO_x$) and 40 g/BHP-hr carbon monoxide (CO) to 1.5 g/BHP-hr, HC, 25 g/BHP-hr CO, and 10 g/BHP-hr HC$+NO_x$. Also, a more stringent peak smoke opacity standard for Diesel engines was proposed. The current peak smoke opacity is 50 percent and the proposed level was 35 percent.

Other proposed changes included test procedure and instrumentation revisions. Several significant changes for both gasoline-fueled and Diesel engine sampling and analytical systems were proposed. Hydrocarbons (HC) would be measured by a heated flame ionization detector (HFID), replacing the present non-dispersive infrared (NDIR) analyzer used in testing gasoline-fueled engines. The Diesel test procedure already uses an HFID. Oxides of nitrogen would be measured by a chemiluminescence (CL) analyzer instead of the current NDIR instruments. The CL analyzer, when coupled with a reducing converter, would measure total oxides of nitrogen (NO $+NO_2$) and not just nitrict oxide (NO) as is the case with the current NDIR analyzers.

Concurrent with the change in exhaust gas analyzers, changes to the exhaust sample conditioning and transport system were proposed. These revisions in sample line length, sample transit time, arrangements, heating requirements, etc. were considered necessary to insure accurate results. Calibration procedures and instrument checks were revised accordingly.

Air-flow measurement of gasoline-fueled engines was also proposed in order to provide a basis for calculating the wet to dry sample correction factor (Kw), and also to compute a measured air-fuel ratio. The measured air-fuel ratio could then be compared to the air-fuel ratio calculated from the exhaust gas constituents. This would serve as the only overall system quality control check. Measured and calculated values were to agree within 10 percent for a valid test.

Several changes were also proposed to the test cycle for both gasoline-fueled and Diesel engines. For gasoline-fueled engines a change to engine torque to define the various operating modes (instead of engine manifold vacuum) for the 9-mode test was most significant. Two other related changes in the 9-mode test procedures were proposed. First, time in mode was increased to a uniform 60 seconds for each mode. Second, the number of cycles per test was reduced from 4 to 2.

Only one significant change was made in the Diesel 13-mode test cycle. The time in mode was reduced from 10 minutes per mode to 5 minutes per mode to significantly reduced the time required to complete an entire test.

The 90-day comment period on the proposed rules ended August 23, 1976. Twenty-two (22) commenters responded to the request for comments. The bulk of the comments received were from the heavy-duty engine manufacturers. After analyzing the comments, EPA identified several major issues associated with the proposed action. They are: (1) lead time, (2) need for revised test procedures and instrument changes, (3) gasoline emission test cycle percent torque values, (4) emission standards, (5) technological impact, (6) fuel economy, (7) performance, (8) engine and vehicle costs, (9) certification and testing costs, (10) cost effectiveness, and (11) medium-duty Diesel engine test procedures. Each of these issues is discussed in this preamble.

In response to the comments, EPA in this final rulemaking has made 6 significant revisions to the regulations initially proposed:

1. For 1979 only, optional use of the existing test procedures and instrumentation will be allowed. Standards generally equivalent in stringency to these newly promulgated standards will be required to be met for 1979 when using these optional procedures. In addition, optional compliance with a standard of 5 g/BHP-hr HC$+NO_x$ and 25 g/BH-hr CO may be demonstrated using either the existing or new test procedures. All subsequent emission testing (1980 and later) will be by the new test procedures, with the exception of small volume manufacturers, who will afford the option of continuing to use the existing test procedures. For 1980 and subsequent model years compliance may be demonstrated to the originally proposed emission standards (1.5 g/BHP-hr HC, 25 g/BHP-hr CO, and 10 g/BHP-hr $+NO_x$ or the more stringent (5 g/BHP-hr HC$+NO_x$ and 25 g/BHP-hr CO) levels at the option of the manufacturer.

2. EPA has decided not to promulgate the proposed 35 percent peak smoke opacity standard for Diesel engines. The current 50 percent peak smoke opacity standard will remain in effect.

3. The requirement for compliance, without deviation, with a specified analysis system schematic has been deleted. Instead, minimum requirements and performance specifications are substituted. The detailed schematic remains to provide guidance only.

4. The requirement for intake air-flow measurement for gasoline-fueled engines was deleted.

5. A chemiluminescence analyzer was specified for NO_x measurement in the NPRM. In the final rule a chemiluminescence analyzer or a high performance NDIR analyzer with an NO_2 to NO converter is specified for NO_x measurement. An option to allow the use of current NDIR analyzers with an NO_2 to NO converter is also included.

6. The CO_2 measurement for Diesel engines, required in the NPRM, is made optional in the final rule.

Discussion of Major Issues

LEAD TIME

The commenters claimed that there is insufficient lead time to comply with the regulations as proposed for the 1979 model year. EPA's analysis supports the manufacturers' claim that lead time for implementing the new instrumentation and test procedures is tight for the 1979 model year. Consequently, EPA is promulgating the emission standards for 1979 and subsequent model years, but is allowing the continued use of the existing test procedures and instrumentation to demonstrate compliance for 1979. All subsequent demonstrations of compliance (1980 and later) will

[1] Grams per brake horsepower-hour (g/BHP-hr) is the method of choice for expressing engine emission standards since engine emissions must be expressed in terms of units of work performed rather than in terms of grams per mile as is the case with vehicles.

be only by the new test procedures (with the exception of small volume manufacturers), and compliance may be demonstrated to the originally proposed standards (1.5 HC, 25 CO, 10 HC+NO_x or the more stringent levels (5.0 HC +NO_x, 25 CO) at the option of the manufacturer.

Heavy-duty engine test data submitted prior to the 1980 model year may be used in subsequent model years' certification without regard to the test procedure used to generate the data. Any heavy-duty engine that is certified in the 1979 model year may be certified for 1980 and later model years on a carryover basis if no changes in the engine are made to the 1979 certified configuration that would require a new demonstration of compliance. If a new demonstration of compliance is required because of design or calibration changes on the 1980 or later model year engine and/or emission control systems, the new test procedures and standards will apply.

The following chart lists the optional combinations of emission standards and test procedures applicable beginning in 1979. These optional standards are not considered to be absolutely equivalent in stringency to the primary standards but are being allowed to ease the tight lead time situation.

	Engine type	Test procedures and instrumentation	Emission standards (grams per brake horsepower-hour)		
			Hydrocarbons[1]	Carbon monoxide	Hydrocarbons plus oxides of nitrogen
Primary standards applicable to 1979 and later.	Gasoline and diesel.	New	1.5	25	10.0
				25	5.0
Optional standards applicable to 1979 model year only.	Diesel	Current	1.5	25	10.0
	Gasoline and diesel.	do		25	5.0
	Gasoline	do	1.0	25	9.5

[1] The current regulations for gasoline engines specify hydrocarbon measurement by nondispersive infrared. However, the new procedures require heated flame ionization detector (HFID). The empirical HFID to NDIR ratio is about 1.5. The current procedures for diesel engines already require a HFID for HC measurement.

Test Procedure and Instrumentation Changes

EPA proposed in the heavy-duty NPRM various equipment specifications and equipment operational procedures to insure that the emission levels are measured accurately and precisely. Among the equipment specifications proposed were chemiluminescence for NO_x measurement (currently measured by NDIR), heated flame ionization detector for gasoline engine HC measurement (currently measured by NDIR), intake air-flow measurement for gasoline-fueled engines, and CO_2 measurement for Diesel engines. The operational procedures proposed included analytical system leak checks, HC hang-up checks, and response-time checks. More detailed analyzer checkout, optimization, and calibration and test procedures were also proposed.

The commenters questioned the need for the extensive test procedure and instrumentation changes proposed. After analyzing the manufacturers' comments and re-evaluating the need for the proposed test procedure and instrumentation changes, EPA has made the following major revisions to the heavy-duty NPRM:

(a) The requirement for use of a specified analysis system designed without deviation in accordance with EPA's schematic diagram has been deleted. Instead, minimum requirements and performance specifications are substituted. The detailed schematic diagram remains to provide guidance only.

(b) The requirement for intake air-flow measurement for gasoline-fueled engines was deleted.

(c) A chemiluminescence analyzer or high performance NDIR analyzer with an NO_2 to NO converter is specified for NO_x measurement. An option to allow the use of current NDIR analyzers with an NO_2 to NO converter is also included.

(d) The CO_2 measurement is made optional for Diesel engines.

Other minor changes in specifications, tolerances, and procedures were made to provide greater flexibility in complying with the regulations. Detailed discussions of these changes can be found in Appendix I of the "Summary and Analysis of Comments to the NPRM: Revised Heavy-Duty Engine Regulations for 1979 and Later Model Years".

Additionally, variations from the test procedure requirement are permitted if equivalency is proven.

Recent investigations related to the HC measurement system for light-duty Diesels have indicated that the current procedure, which is designed to measure essentially all HC emissions, may result in the measurement of some hydrocarbons that do not contribute to the formation of photochemical smog. It has been suggested that the heated sample system, since it is maintained at high temperature (375° F), measures HC compounds in the vapor state that might normally condense as aerosols in the atmosphere without contributing to smog formation.

The standards now being finalized for heavy-duty engines include the requirement for measurement of HC by means of a heated flame ionization detector (HFID). While this has always been the procedure for heavy-duty Diesel engines, the use of an HFID for gasoline engines is a new requirement. The requirement for such a procedure is being retained for the following reasons even though the issue regarding the appropriateness of measuring HC aerosols is not yet fully resolved:

1. The new heavy-duty engine standards are interim standards which were based on technology limitations and not ultimate air quality needs. Air quality needs would have dictated even more stringent standards. These technology-based standards were developed by considering the lowest emission levels achievable with currently available technology and with measurements being made with an HFID. Until more stringent long term standards are adopted based on air quality needs, there is no need to address further the issue regarding what HC compounds should or should not be regulated.

2. The HC standards was developed by considering the lowest level currently achievable with gasoline engines. This was determined to be 1.0 g/BHP-hr on a "cold basis" using a non-dispersive infrared analyzer. The new standards were adjusted upward to 1.5 g/BHP-hr to account for the fact that the new procedure using an HFID results in higher amounts of HC being recorded. This approach was taken to allow the use of an HFID which avoids HC hang-up problems and provides for a more reliable and repeatable test.

3. Diesel engines certified under current regulations, on the average, have had HC levels well below the 1.5 g/BHP-hr standard being adopted for 1979. The average HC level for 1974 Diesel certification engines was 0.92 g/BHP-hr. These measurements were on a total HC basis using an HFID. Thus, the new regulations will not have caused any undue hardship on Diesel engine manufacturers regardless of the outcome of the total HC measurement issue.

4. If a new test procedure would be developed which eliminated the measurement of any HC compounds that should not be counted, these interim standards would have to be readjusted to reflect the change. At least in the case of Diesel engines if less HC was going to be measured, the combined HC plus NO_x standard would have to be lowered to retain the desired level of NO_x control. That is, without changing the HC+NO_x standard, a new procedure recording less HC would allow a manufacturer a greater margin in the effective NO_x standard. The result would be to require less than the maximum control of NO_x achieveable with current technology. This would be a severe compromise, since in the case of Diesel engines, additional NO_x control is the only significant impact of the regulations.

Gasoline Emission Test Cycle Percent Torque Values

EPA proposed to replace the 19, 16, 10 and 3 in-Hg (manifold vacuum) load levels in the 9-mode gasoline Federal Test Procedure (FTP) with percent torque values of 10, 25, 55, and 90, respectively. In general, the gasoline engine manufacturers disagreed with the 90 percent and 55 percent torque equivalents to replace the 3 in-Hg and 10 in-Hg power levels. EPA re-examined its data base and incorporated into it data sup-

plied by the commenters. The data analysis indicates that the 90 percent and 55 percent torque values were correct. Most importantly, the latest truck operational data available to EPA (CAPE–21) clearly demonstrated that a substantial amount of truck operation was above 90 percent. EPA has therefore retained the proposed percent torque values in the final regulation.

Emission Standards

In general, the comments submitted indicated that the proposed heavy-duty standards could be met by all of the manufacturers with the use of currently available emission control technology. The majority of the commenters did not object to the proposed gaseous emission standards. EPA has retained the proposed gaseous emission standards in the final regulation.

Several commenters questioned EPA's rationale for proposing to reduce the Diesel smoke opacity from 50 percent to 35 percent and projected losses in acceleration performance to achieve compliance. Based on EPA's analysis, it appears that the Diesel manufacturers can meet the proposed peak smoke standard with a low level of effort and little or no cost. Nearly all Diesel engine families already meet a peak smoke level of 35 percent. On the other hand, an air quality benefit obtained by reducing the current peak smoke level is not readily identifiable. Moreover, if the claimed losses in acceleration in fact occur, and in the face of major technical difficulties in enforcing in the field the difference between a 35 percent and 50 percent opacity standard, widespread misadjustment in the field to regain a performance feature important to the driver might be common. In light of the above facts, EPA deleted the proposed 35 percent peak smoke opacity in the final rule. The current 50 percent peak smoke opacity remains in effect.

Technological Impact of the Proposed Emission Standards

All the manufacturers indicated that the proposed heavy-duty emission standards for 1979 could be met with the use of currently available emission control technology. Thus, the manufacturers did not take issue with EPA's premise that the technology to meet the proposed standards is available. Rather, the commenters summarized the technological impact of the proposed standards. Also, several manufacturers pointed out areas of disagreement in the supporting documents to this regulatory action. The most important issues raised by the manufacturers are:

1. Catalyst technology may be necessary for gasoline engines to meet the proposed standards; and,

2. The proposed standards will force discontinuance of naturally aspirated Diesel engines and require the use of intercoolers and turbochargers.

On the first point, EPA maintains that the proposed emission standards are achievable with currently available control technology. Further, EPA believes that the standards are obtainable without the use of catalysts or of costly and unproven technology. (The General Motors statements support EPA's position on this). However, EPA recognizes that catalyst technology may be an alternative for some manufacturers, especially if fuel economy needs to be maximized without using sophisticated engine improvements.

On the second point, EPA believes that the existing trend toward Diesel engines that use intercoolers and turbochargers is only marginally related to the emission standards. The trend toward constant speed (55 mph) heavy-duty vehicles equipped with an engine with significant torque backup is in response to the desire for improved fuel economy, not emission control. The manufacturers did not submit data that would demonstrate that turbochargers and intercoolers are required to meet the emission standards. Most importantly, a maximum increase of only 4 percent in the use of turbocharges may occur. Therefore, EPA views the costs of intercoolers and turbochargers as not being properly chargeable to the emission control standards.

Fuel Economy

The major Diesel engine manufacturers stated that, when compared to fuel efficiency of existing engines, no fuel economy penalty will result in complying with the proposed emission standards though some potential fuel economy gains may be foregone. On the other hand, the gasoline engine manufacturers have claimed fuel economy penalties ranging from zero to 20 percent. After evaluating the manufacturers' comments, EPA concluded that Diesel engines will not suffer any real fuel economy penalty as a result of the proposed action. However, gasoline engines may have an industry-wide fuel economy penalty anywhere from zero to 5 percent. (The 5 percent figure represents a projection of a sales weighted average fuel economy penalty based on the data submitted by the industry and assumes very limited use of catalyst control technology.) EPA views the 5 percent limit as a worst-case temporary penalty for several reasons. One manufacturer, accounting for over 30 percent of the market, has indicated that he will be able to produce in model year 1979 engines equipped with non-catalyst technology that will not experience a fuel penalty. Over time, other manufacturers should be able to develop similar technologies for use on their engines. Manufacturers could also elect to perfect the use of catalyst technology on heavy-duty gasoline engines to optimize fuel economy.

In general, utilization of fuel efficient emission control technologies by all manufacturers by the 1979 model year is probably precluded at this time, though in one to three years after that manufacturers should have been able to perfect these systems. Certainly the current operating environment for heavy-duty engines is such that the need to conserve energy and limit operating expenses are recognized, and should provide engine manufacturers an incentive to develop fuel efficient technologies. Thus, any fuel penalty which does occur in 1979 should disappear in one to three years' time.

Performance

One gasoline-fueled engine manufacturer claimed that the imposition of the more stringent gaseous emission standards would have a deleterious effect on vehicle performance. Based on evaluation of the comments, EPA agrees that some loss in acceleration for gasoline-fueled vehicles could occur in meeting the proposed emission standards. The magnitude of these possible losses and the associated impacts could not be quantified. On the other hand, competitive market pressures should cause manufacturers to maintain more than acceptable levels of vehicle performance in their products.

Engine and Vehicle Costs

EPA stated in the preamble to the NPRM that the retail price increase per engine would be approximately $110 for gasoline and $120 for Diesel. Except for International Harvester Corp. and General Motors, the gasoline engine manufacturers agreed fairly closely with EPA's estimate. Averaging Ford's, Chrysler's and EPA's estimates results in a cost increase of $120 for gasoline vehicles. This cost increase projection ($120) will replace EPA's original estimate of $110.

The Diesel manufacturers claimed the need for turbochargers to meet the proposed regulations. As explained in the issue on technological impact, EPA has concluded that turbochargers are used primarily to improve fuel economy. A side effect may be lower emissions, but EPA estimates that to meet the 1979 standards improved fuel systems and EGR (exhaust gas recirculation) will suffice, at a total projected cost of $130.

Over a five-year period it will cost the industry approximately $350 million to comply with this regulation assuming no fuel penalty occurs. Approximately $5 million of this is the cost for modifying industry emission test cells to comply with the new regulations and $6 to $8 million for recertification of engines. If a five percent fuel penalty occurs for gasoline-fueled engines, the five-year costs of compliance increases between $200 to $560 million depending upon whether the fuel penalty is incurred for one year only or all five.

Certification and Testing Costs

Several manufacturers commented that EPA's estimates of the costs to certify heavy-duty engines were too low. The expense of running a certification program for heavy-duty engines is not the primary cost passed on to the vehicle purchaser. The emission control system hardware is the major factor. But, if the manufacturers' most pessimistic estimates were used, the overall cost effectiveness of this regulation would not be appreciably affected. Based on conversations with independent laboratories and experience with EPA contracts, it is esti-

mated that certification costs per test engine will be approximately the same as stated in the draft Environmental and Inflationary Impact Statement:

	Durability	Emission data
Diesel	$50,000	$15,000
Gasoline	55,000	10,000

For the typical Diesel engine family with 3000 sales/year and a 3-year certification life, the straight-line amortized cost is about $10 per engine. Gasoline engine families will have lower unit costs due to larger sale volumes.

Cost Effectiveness

Based on the re-evaluation of baseline emission and fuel economy impacts, the cost effectiveness of the standards was recalculated.

From the comments, it appears that a fuel economy penalty (for gasoline engines) of zero to 5 percent may result from imposing the proposed regulation (refer to discussion of the Fuel Economy Issue above). This possible fuel economy impact was factored into the cost effectiveness analysis. For purposes of comparison with other programs, a mid-range value of 2.5 percent fuel economy penalty was assumed for gasoline engines. A zero percent fuel economy penalty was assumed for Diesel engines. The following costs effectiveness figures were obtained:

	Dollars ($) per ton		
	Hydrocarbon	Carbon monoxide	Oxides of nitrogen
Gasoline	154	71	347
Diesel			129

The results indicated that at moderate levels of fuel economy penalty, this action remains cost effective. EPA has used the above values for the cost effectiveness of this regulation. EPA anticipates that any fuel economy penalty which may initially occur will most likely disappear, as stated previously. This will improve the cost effectiveness for subsequent model years.

Diesel Engine Test Procedures for Medium-Duty Application

Currently, the vast majority of all Diesel truck engines are used in vehicles over 26,000 pounds GVWR. The present Diesel engine test procedure was designed specifically for these heavy-duty applications. With increased fuel prices, there is a trend toward installing Diesels in lighter trucks for medium-duty (approximately 8,500–26,000 pounds GVWR) applications. EPA solicited comments on changes to the test procedure to accommodate this trend.

In response to EPA's request, the commenters recommended the following changes in the Diesel test procedure: (1) Optional, less severe certification for trucks up to 26,000 pounds GVWR, (2) revised durability and emission test cycles, and (3) useful life reduced to 5 years/50,000 miles. The commenters did not provide any substantial information or data that could be relied upon as a basis for developing a new class, test procedures, or a redefinition of useful life for a Diesel engine in medium-duty applications. Data available to EPA indicate to EPA that the recommended changes are not called for.

EPA has made no changes in the Diesel engine class definition, test procedures, or useful life at this time. However, if the manufacturers want to certify and build a Diesel engine for medium-duty application, they are encouraged to submit data that demonstrate that the current Diesel test procedures are unreasonable or unrealistic for emission testing. They are also encouraged to submit data and recommendations for an alternative test procedure that would be appropriate for the engine in question. Section 86.079–27, Special Test Procedures (corresponds to § 86.077–27 of existing regulations) of the regulations provides the means for the manufacturers to request special test procedures for emissions testing. If the test procedures specified in Subparts D and J can be shown to be unsatisfactory for testing of a particular power plant, the Administrator has the authority to prescribe alternate procedures. Since it does not appear that there is an urgent requirement for such modified Diesel engine test procedures, § 86.079–27 should serve as an adequate interim means of dealing with this issue until a formal test procedure for medium-duty application can be promulgated, should the need arise.

Additional Information

Comments which were received in response to the NPRM are available for inspection and copying during normal business hours at the U.S. Environmental Protection Agency, Public Information Reference Unit, Room 2922 (EPA Library), 401 M St. SW., Washington, D.C. 20460. As provided for in 40 CFR Part 2, a reasonable fee may be charged for copying services.

Single copies of EPA's detailed analysis of comments received, entitled "Summary and Analysis of Comments to the NPRM: Revised Heavy-Duty Engine Regulations for 1979 and Later Model Years," dated July 1977, as well as copies of the Final Environmental Impact Statement, entitled "Environmental Impact Statement: Emission Standards for New Heavy-Duty Engines," dated August 4, 1977, are available upon request from the Printing Management Section (PM–215), U.S. Environmental Protection Agency, 401 M St. SW., Washington, D.C. 20460.

Readers are alerted that, due to enactment of the Clean Air Act Amendments of 1977 on August 7, 1977, certain provisions of the regulations applicable to light-duty motor vehicles intended for sale at high-altitude locations which are being reprinted herein are no longer in effect. In order not to delay the issuance of this regulation, these provisions have not been removed from this document. EPA intends to modify its high-altitude certification regulations in the near future in order to conform those regulations to the recently enacted law.

Note:—The Environmental Protection Agency has determined that this document contains a major regulation requiring preparation of an Economic Impact Analysis under Executive Orders 11821 and 11949, and OMB Circular A–107 and certifies that an Economic Impact Analysis has been prepared.

Dated: August 22, 1977.

Douglas M. Costle,
Administrator.

40 CFR Part 86 is amended as follows:

Subpart A—General Provisions for Emission Regulations for 1977 and Later Model Year New Light-Duty Vehicles, 1977 and Later Model Year New Light-Duty Trucks, and for 1977 and Later Model Year New Heavy-Duty Engines

1. Paragraph (a) of § 86.077–2 is revised to read as follows:

§ 86.077–2 Definitions.

(a) The definitions in this section apply to this subpart and also to Subparts B, D, H, I, and J of this part.

* * * * *

2. Paragraph (a) of § 86.078–3 is revised to read as follows:

§ 86.078–3 Abbreviations.

(a) The abbreviations in this section apply to this subpart and also to Subparts B, D, H, I, and J of this part and have the following meanings:

* * * * *

3. Section 86.079–2 is revised by adding the following definitions interspersed among the existing definitions in alphabetical order.

§ 86.079–2 Definitions.

* * * * *

"Curb-idle" for manual transmission code heavy-duty engines means the manufacturer's recommended engine speed with the transmission in neutral or with the clutch disengaged. For automatic transmission code heavy-duty engines, curb-idle means the manufacturer's recommended engine speed with the automatic transmission in gear and the output shaft stalled.

* * * * *

"Dynamometer-idle" for automatic transmission code heavy-duty engines means the manufacturer's recommended engine speed without a transmission that simulates the recommended engine speed with a transmission and with the transmission in neutral.

* * * * *

"Gross vehicle weight rating" (GVWR) means the value specified by the manufacturer as the maximum design loaded weight of a single vehicle.

"Hang-up" refers to the process of hydrocarbon molecules being absorbed, adsorbed, condensed, or by any other method removed from the sample flow prior to reaching the instrument detector. It also refers to any subsquent desorption of the molecules into the sample flow when they are assumed to be absent.

"Intermediate speed" means peak torque speed if peak torque speed occurs between 60 and 75 percent of rated speed. If the peak torque speed is less than 60 percent of rated speed, intermediate speed means 60 percent of rated speed. If the peak torque speed is greater than 75 percent of rated speed, intermediate speed means 75 percent of rated speed.

* * * * *

4. A new § 86.079–10 is added and reads as follows:

§ 86.079–10 Emission standards for 1979 gasoline-fueled heavy-duty engines.

(a) Exhaust emissions from new 1979 model year gasoline-fueled heavy-duty engines shall not exceed one of the three following standards, to be selected at the manufacturer's option:

(1) As measured in Subpart D of this part:

(i) *Hydrocarbons.* 1.5 grams per brake horsepower hour.

(ii) *Carbon monoxide.* 25 grams per brake horsepower hour.

(iii) *Hydrocarbons plus oxides of nitrogen.* 10 grams per brake horsepower hour.

(2) As measured in Subpart H of this part:

(i) *Hydrocarbons.* 1.10 gram per brake horsepower hour.

(ii) *Carbon monoxide.* 25 grams per brake horsepower hour.

(iii) *Hydrocarbons plus oxides of nitrogen.* 9.5 grams per brake horsepower hour.

(3) As measured in Subparts D or H of this part:

(i) *Hydrocarbons plus oxides of nitrogen.* 5 grams per brake horsepower hour.

(ii) *Carbon monoxide.* 25 grams per brake horsepower hour.

(b) [Reserved].

(c) No crankcase emissions shall be discharged into the ambient atmosphere from any new 1979 and later model year gasoline-fueled heavy-duty engine.

(d) Every manufacturer of new motor vehicle engines subject to the standards prescribed in this section shall, prior to taking any of the actions specified in section 203(a)(1) of the Act, test or cause to be tested motor vehicle engines in accordance with applicable procedures in Subparts D or H of this part to ascertain that such test engines meet the requirements of paragraphs (a) and (c) of this section.

5. A new § 86.079–11 is added and reads as follows:

§ 86.079–11 Emission standards for 1979 Diesel heavy-duty engines.

(a) Exhaust emissions from new 1979 model year Diesel heavy-duty engines shall not exceed one of the two following standards, to be selected at the manufacturer's option:

(1) As measured in Subparts D or J of this part:

(i) *Hydrocarbons.* 1.5 grams per brake horsepower hour.

(ii) *Carbon monoxide.* 25 grams per brake horsepower hour.

(iii) *Hydrocarbons plus oxides of nitrogen.* 10 grams per brake horsepower hour.

(2) As measured in Subpart D or J of this part:

(i) *Hydrocarbons plus oxides of nitrogen.* 5 grams per brake horsepower hour.

(ii) *Carbon monoxide.* 25 grams per brake horsepower hour.

(b) (1) The opacity of smoke emissions from new 1979 and later model year Diesel heavy-duty engines shall not exceed:

(i) 20 percent during the engine acceleration mode.

(ii) 15 percent during the engine lugging mode.

(iii) 50 percent during the peaks in either mode.

(2) The standards set forth in paragraph (b)(1) of this section refer to exhaust smoke emissions generated under the conditions set forth in Subpart I of this part and measured and calculated in accordance with those procedures.

(c) [Reserved]

(d) Every manufacturer of new motor vehicle engines subject to the standards prescribed in this section shall, prior to taking any of the actions specified in section 203(a)(1) of the Act, test or cause to be tested motor vehicle engines in accordance with applicable procedures in Subpart D, I, or J of this part to ascertain that such test engines meet the requirements of paragraphs (a) and (b) of this section.

6. Section 86.079–21 is amended to read as follows:

§ 86.079–21 Application for certification.

(a) A separate application for a certificate of conformity shall be made for each set of standards and each class of new motor vehicles or new motor vehicle engines. Such application shall be made to the Administrator by the manufacturer and shall be updated and corrected by amendment.

(b) The application shall be in writing, signed by an authorized representative of the manufacturer, and shall include the following:

(1) Identification and description of the vehicle (or engines) covered by the application and a description of their engine (vehicles only), emission control system, and fuel system components. This shall include a detailed description of each AECD to be installed in or on any certification test vehicle (or certification test engine).

(2) Projected U.S. sales data sufficient to enable the Administrator to select a test fleet representative of the vehicles (or engines) for which certification is requested.

(3) A description of the test equipment and fuel proposed to be used.

(4) (i) A description of the proposed mileage (or service) accumulation procedure for durability testing.

(ii) A description of the test procedures to be used to establish the evaporative emission deterioration factors required to be determined and supplied in § 86.079–23(a)(2).

(5) A statement of recommended maintenance and procedures necessary to assure that the vehicles (or engines) covered by a certificate of conformity in operation conform to the regulations, and a description of the program for training of personnel for such maintenance, and the equipment required.

(6) At the option of the manufacturer, the proposed composition of the emission-data and durability-data test fleet.

(c) Complete copies of the application and of any amendments thereto, and all notifications under §§ 86.079–32, 86.079–33, and 86.079–34 shall be submitted in such multiple copies as the Administrator may require.

(d) Incomplete light duty trucks shall have a maximum completed curb weight and maximum completed frontal area specified by the manufacturer.

7. New §§ 86.079–22 through 86.079–25 are added and read as follows:

§ 86.079–22 Approval of application for certification; test fleet selections.

(a) After a review of the application for certification and any other information which the Administrator may require, the Administrator may approve the application and select a test fleet in accordance with § 86.079–24.

(b) The Administrator may disapprove in whole or in part an application for certification for reasons including incompleteness, inaccuracy, inappropriate proposed mileage (or service) accumulation procedures, test equipment, or fuel, and incorporation of defeat devices in vehicles (or on engines) described by the application.

(c) Where any part of an application is rejected, the Administrator shall notify the manufacturer in writing and set forth the reasons for such rejection. Within 30 days following receipt of such notification, the manufacturer may request a hearing on the Administrator's determination. The request shall be in writing, signed by an authorized representative of the manufacturer and shall include a statement specifying the manufacturer's objections to the Administrator's determinations, and data in support of such objections. If, after the review of the request and supporting data, the Administrator finds that the request raises a substantial factual issue, he shall provide the manufacturer a hearing in accordance with § 86.078–6 with respect to such issue.

(d) The Administrator does not approve the test procedures for establishing the evaporative emission deterioration factors. The manufacturer shall submit the procedures as required in § 86.079–21(b)(4)(ii) prior to the Administrator's selection of the test fleet under § 86.079–24(b)(1) and if such procedures will involve testing of durability-data vehicles selected by the Administrator or elected by the manufacturer under § 86.079–24(c)(1), prior to initiation of such testing.

§ 86.079–23 Required data.

(a) The manufacturer shall perform the tests required by the applicable test procedures, and submit to the Adminis-

trator the following information: *Provided, however,* That:

(1) If requested by the manufacturer, the Administrator may waive any requirement of this section for testing of vehicles (or engines) for which emission data are available, or will be made available, under the provisions of § 86.079–29, or

(2) If requested by the manufacturer, the Administrator may waive any requirement of this section for testing of vehicles at zero kilometers of operation.

(b) (1) Exhaust emission durability data on such vehicles (or engines) tested in accordance with applicable test procedures and in such numbers as specified, which will show the performance of the systems installed on or incorporated in the vehicle (or engine) for extended mileage (or extended operation), as well as a record of all pertinent maintenance (all maintenance and servicing for heavy-duty engines) performed on the test vehicles (or test engines). Records of maintenance and servicing of heavy-duty engines performed prior to the zero-hour point do not need to be submitted but must be maintained.

(2) Evaporative emission deterioration factors for each evaporative emission family—evaporative emission control system combination and all test data that are derived from testing described under § 86.079–21(b)(4)(ii) designed and conducted in accordance with good engineering practice to assure that the vehicles covered by a certificate issued under § 86.079–30 will meet the evaporative emission standards in § 86.078–8 or § 86.079–9, as appropriate, for the useful life of the vehicle.

(c) Emission data.

(1) *Certification vehicles.* (i) Emission data on such vehicles tested in accordance with applicable test procedures and in such numbers as specified, which will show their emissions after zero kilometers (zero miles) and 6,436 kilometers (4,000 miles) of operation.

(ii) Emission data on those vehicles selected under § 86.079–24(b)(1)(v) and § 86.079–24(b)(1)(vii)(D) and tested in accordance with the applicable test procedures of this subpart and in such numbers as therein specified, which shall be tested at zero kilometers (zero miles) at any altitude, and under high-altitude conditions after 6,436 kilometers (4,000 miles) of operation at any altitude.

(2) *Certification engines.* Emission data on such engines tested in accordance with applicable emission test procedures and in such numbers as specified, which will show their emissions after 125 hours of operation. A zero-hour test may be performed after the engine has been approved by the Administrator to begin service accumulation.

(d) A statement that the vehicles (or engines) for which certification is requested conform to the requirements in § 86.078–5(b), and that the descriptions of tests performed to ascertain compliance with the general standards in § 86.078–5(b), and the data derived from such tests, are available to the Administrator upon request.

(e) (1) A statement that the test vehicles (or test engines) with respect to which data are submitted to demonstrate compliance with §§ 86.078–8, 86.079–9, 86.079–10, 86.079–11, 86.080–10, or 86.080–11, as applicable, are in all material respects as described in the manufacturer's application for certification, have been tested in accordance with the applicable test procedures utilizing the fuels and equipment described in the application for certification and that on the basis of such tests the vehicles (or engines) conform to the requirements of the regulations in this part. If such statements cannot be made with respect to any vehicle (or engine) tested, the vehicle (or engine) shall be identified, and all pertinent data relating thereto shall be supplied to the Administrator. If, on the basis of the data supplied and any additional data as required by the Administrator, the Administrator determines that the test vehicle (or test engine) was not as described in the application for certification or was not tested in accordance with the applicable test procedures utilizing the fuels and equipment as described in the application for certification, the Administrator may make the determination that the vehicle (or engine) does not meet the applicable standards. The provisions of § 86.079–30(b) shall then be followed.

(2) For evaporative emission durability, the statement of compliance with paragraph (b)(2) of this section.

§ 86.079–24 Test vehicles and engines.

(a) (1) The vehicles or engines covered by an application for certification will be divided into groupings of engines which are expected to have similar emission characteristics throughout their useful life. Each group of engines with similar emission characteristics shall be defined as a separate engine family.

(2) To be classed in the same engine family, engines must be identical in all the following respects:

(i) The cylinder bore center-to-center dimensions.

(ii) The dimension from the centerline of the crankshaft to the centerline of the camshaft.

(iii) The dimension from the centerline of the crankshaft to the top of the cylinder block head face.

(iv) The cylinder block configuration (air cooled or water cooled; L–6, 90° V–8, etc.).

(v) The location of intake and exhaust valves, (or ports) and the valve (or port) sizes (within a ¼-inch range on the valve head diameter or within 10 percent on the port area).

(vi) The method of air aspiration.

(vii) The combustion cycle.

(viii) Catalytic converter characteristics.

(ix) Thermal reactor characteristics.

(x) Type of air inlet cooler (e.g., intercoolers and after-coolers) for Diesel heavy-duty engines.

(3) Engines identical in all the respects listed in paragraph (a)(2) of this section may be further divided into different engine families if the Administrator determines that they may be expected to have different emission characteristics. This determination will be based upon a consideration of the following features of each engine.

(i) The bore and stroke.

(ii) The surface-to-volume ratio of the nominally dimensioned cylinder at the top dead center position.

(iii) The intake manifold induction port size and configuration.

(iv) The exhaust manifold port size and configuration.

(v) The intake and exhaust valve sizes.

(vi) The fuel system.

(vii) The camshaft timing and ignition or injection timing characteristics.

(4) Where engines are of a type which cannot be divided into engine families based upon the criteria listed in paragraphs (a)(2) and (3) of this section, the Administrator will establish families for those engines based upon the features most related to their emission characteristics.

(5) The gasoline-fueled vehicles covered by an application for certification will be divided into groupings which are expected to have similar evaporative emission characteristics throughout their useful life. Each group of vehicles with similar evaporative emission characteristics shall be defined as a separate evaporative emission family.

(6) To be classed in the same evaporative emission family, vehicles must be identical in all of the following respects:

(i) Type of vapor storage device (e.g., canister, air cleaner, crankcase).

(ii) Basic canister design.

(iii) Fuel system.

(7) Where vehicles are of a type which cannot be divided into evaporative emission families based on the criteria listed above, the Administrator will establish families for those vehicles based upon the features most related to their evaporative emission characteristics.

(b) Emission data: (1) *Emission-data vehicles.* Paragraph (b)(1) of this section applies to light-duty vehicle and light-duty truck emission-data vehicles.

(i) Vehicles will be chosen to be operated and tested for emission data based upon the engine family groupings. Within each engine family, the requirements of this paragraph must be met.

(ii) Vehicles of each engine family will be divided into engine displacement-exhaust emission control system combinations as applicable. A projected sales volume will be established for each combination for the model year for which certification is sought. One vehicle of each combination will be selected in order of decreasing projected sales volume until 70 percent of the projected sales of a manufacturer's total production of vehicles of that engine family is represented, or until a maximum of four vehicles is selected. If any single combination represents over 70 percent, then two vehicles of that combination may be selected. The vehicle selected for each combination will be specified by the Administrator as to such features as engine code, transmission type, fuel system, and inertia weight class.

(iii) The Administrator may select a maximum of four additional vehicles within each engine family based upon features indicating that they may have the highest emission levels of the vehicles in that engine family. In selecting these vehicles, the Administrator will consider such features as the emission control system combination, induction system characteristics, ignition system characteristics, fuel system, rated horsepower, rated torque, compression ratio, inertia weight class, transmission options, and axle ratios.

(iv) If the vehicles selected in accordance with paragraphs (b)(1)(ii) and (iii) of this section do not represent each engine-system combination, then one vehicle of each engine-system combination not represented will be selected by the Administrator. The vehicle selected shall be of the engine displacement with the largest projected sales volume of vehicles with the control system combination in the engine family and will be designated by the Administrator as to such features as transmission type, fuel system, and inertia weight class.

(v) The Administrator will also select one vehicle for each engine-system combination within an engine family for which vehicles are to be sold to ultimate purchasers at high altitude.

(vi) The Administrator may combine testing requirements for any vehicle selected under paragraph (b)(1)(v) or (b)(1)(vii)(D) of this section with the testing requirements for any similar vehicle in the same engine-system combination selected under paragraph (b)(1)(ii), (iii), or (iv) of this section or any similar vehicle in the same engine-system, evaporative emission family, evaporative emission control system combination selected under paragraph (b)(1)(vii)(A) or (B) of this section. The testing requirements may be combined by the Administrator requiring a vehicle selected for testing under paragraphs (b)(1)(ii), (iii), (iv), (vii)(A), or (vii)(B) of this section to be modified (if necessary) after mileage accumulation and emission testing for the purpose of demonstrating compliance with § 86.079-23(b)(1)(ii).

(vii) (A) Vehicles of each evaporative emission family will be divided into evaporative emission control systems. One vehicle of each evaporative emission control system within the evaporative emission family will be selected.

(B) The Administrator may select a maximum of four (4) additional vehicles within each evaporative emission family based upon features indicating that they may have the highest evaporative emission levels of vehicles in that family.

(C) The Administrator may determine that the vehicles selected under paragraph (b)(1)(ii) through (iv) of this section may be used to satisfy the requirements of paragraph (b)(1)(vii)(A) and (B) of this section.

(D) The Administrator will also select one vehicle for each evaporative emission control system within each evaporative family for which vehicles are to be sold at high altitude.

(E) Vehicles selected under paragraph (b)(1)(v) of this section may be used to satisfy the requirements of paragraph (b)(1)(vii)(D) of this section.

(2) *Gasoline-fueled heavy-duty emission-data engines.* Paragraph (b)(2) of this section applies to gasoline-fueled heavy-duty emission-data engines.

(i) Engines will be chosen to be run for emission data based upon the engine family groupings. Within each engine family, the requirements of this paragraph must be met.

(ii) Engines of each engine family will be divided into engine displacement-exhaust emission control system combinations. A projected sales volume will be established for each combination for the applicable model year. One engine of each combination will be selected in order of decreasing projected sales volume until 70 percent of the projected sales of a manufacturer's total production of engines of that family is represented, or until a maximum of four engines is selected. The engines selected for each combination will be specified by the Administrator as to fuel system.

(iii) The Administrator may select a maximum of two additional engines within each engine family based upon features indicating that they may have the highest emission levels of the engines in that engine family. In selecting these engines, the Administrator will consider such features as the exhaust emission control system, induction system characteristics, ignition system characteristics, fuel system, rated horsepower, rated torque, and compression ratio.

(iv) If the engines selected in accordance with paragraphs (b)(2)(ii) and (iii) of this section do not represent each engine displacement-exhaust emission control system combination, then one engine of each engine displacement-exhaust emission control system combination not represented shall be selected by the Administrator.

(3) *Diesel heavy-duty emission-data engines.* Paragraph (b)(3) of this section applies to Diesel heavy-duty emission-data engines.

(i) Engines will be chosen to be run for emission data based upon engine family groupings. Within each engine family, the requirements of this paragraph must be met.

(ii) Engines of each engine family will be divided into groups based upon their exhaust emission control systems. One engine of each engine-system combination shall be run for smoke emission data and gaseous emission data as prescribed in § 86.079-26(c)(3). Either the complete gaseous emission test or the complete smoke test may be conducted first. Within each combination, the engine that features the highest fuel feed per stroke, primarily at the speed of maximum rated torque and secondarily at rated speed, will usually be selected. If there are military engines with higher fuel rates than other engines in the same engine system combinations, then one military engine shall be also selected. The engine with the highest fuel feed per stroke will usually be selected.

(iii) The Administrator may select a maximum of one additional engine within each engine-system combination based upon features indicating that it may have the highest emission levels of the engines of that combination. In selecting this engine, the Administrator will consider such features as the injection system, fuel system, compression ratio, rated speed, rated horsepower, peak torque speed, and peak torque.

(c) Durability data: (1) *Durability-data vehicles.* Paragraph (c)(1) of this section applies to light-duty vehicle and light-duty truck durability-data vehicles.

(i) A durability-data vehicle will be selected by the Administrator to represent each engine-system combination. The vehicle selected shall be of the engine displacement with the largest projected sales volume of vehicles with that control-system combination in that engine family and will be designated by the Administrator as to transmission type, fuel system, and inertia weight class.

(ii) A manufacturer may elect to operate and test additional vehicles to represent any engine-system combination. The additional vehicles must be of the same engine displacement, transmission type, fuel system, and inertia weight class as the vehicle selected for that engine-system combination in accordance with the provisions of paragraph (c)(1)(i) of this section. Notice of an intent to operate and test additional vehicles will be given to the Administrator not later than 30 days following notification of the test fleet selection.

(2) *Gasoline-fueled heavy-duty durability-data engines.* Paragraph (c)(2) of this section applies to gasoline-fueled heavy-duty durability-data engines.

(i) A durability-data engine will be selected by the Administrator to represent each engine-system combination.

(ii) [Reserved]

(iii) A manufacturer may elect to operate and test additional engines to represent any engine-system combination. The additional engines must be of the same engine displacement and fuel systems as the engine selected for that combination in accordance with the provisions of paragraph (c)(2)(i) of this section. Notice of an intent to run additional engines shall be given to the Administrator not later than 30 days following notification of the test fleet selection. Deterioration factors calenlated for each engine-system combination shall be applied separately to military and nonmilitary engines within the same engine-system combination.

(3) *Diesel heavy-duty durability-data engines.* Paragraph (c)(3) of this section applies to Diesel heavy-duty durability-data engines.

(i) One engine from each engine-system combination shall be tested as prescribed in § 86.079-26(c)(3)(ii). At each test point, either the complete gaseous emission test or the complete smoke test may be conducted first. Within each combination, the engine which features the highest fuel feed per stroke, pri-

marily at rated speed and secondarily at the speed of maximum rated torque, will usually be selected for durability testing. In the case where more than one engine in an engine-system combination has the highest fuel feed per stroke, the engine with the highest maximum rated horsepower will usually be selected for durability testing. If an engine system combination includes both military and nonmilitary engines, then the nonmilitary engine with the highest maximum rated horsepower will usually be selected for durability testing.

(ii) A manufacturer may elect to operate and test additional engines to represent any engine-system combination. The additional engines must be of the same model and fuel system as the engine selected in accordance with the provisions of paragraph (c)(3)(i) of this section. Notice of an intent to test additional engines shall be given to the Administrator not later than 30 days following notification of the test fleet selection. Deterioration factors calculated for each engine-system combination shall be applied separately to military and non-military engines within the same engine system combination.

(d) For purposes of testing under § 86.079-26 (a)(9), (b)(9), or (c)(11), the Administrator may require additional emission-data vehicles (or emission-data engines) and durability-data vehicles (or durability-data engines) identical in all material respects to vehicles (or engines) selected in accordance with paragraphs (b) and (c) of this section: *Provided*, That the number of vehicles (or engines) selected shall not increase the size of either the emission-data fleet or the durability-data fleet by more than 20 percent or one vehicle (or engine), whichever is greater.

(e) Any manufacturer whose projected sales for the model year in which certification is sought is less than

(1) 2000 gasoline-fueled light-duty vehicles, or

(2) 2000 Diesel light-duty vehicles, or

(3) 2000 gasoline-fueled light-duty trucks, or

(4) 2000 Diesel light-duty trucks, or

(5) 2000 gasoline-fueled heavy-duty engines, or

(6) 200 Diesel heavy-duty engines,

may request a reduction in the number of test vehicles (or engines) determined in accordance with the foregoing provisions of this section. The Administrator may agree to such lesser number as he determines would meet the objectives of this procedure.

(f) In lieu of testing an emission-data or durability-data vehicle (or engine) selected under paragraph (b) or (c) of this section, and submitting data therefore, a manufacturer may, with the prior written approval of the Administrator, submit exhaust emission data and/or fuel evaporative emission data, as applicable, on a similar vehicle (or engine) for which certification has previously been obtained or for which all applicable data required under § 86.079-23 have previously been submitted.

(g)(1) This paragraph (g) applies to light-duty vehicles and light-duty trucks.

(2) Where it is expected that more than 33 percent of an engine family will be equipped with an optional item, the full estimated weight of that item shall be included, unless excluded by the Administrator, in the curb weight computation for each vehicle available with that option in the engine family. Where it is expected that 33 percent or less of the vehicles in an engine family will be equipped with an item of optional equipment, no weight for that item will be added in computing curb weight. In the case of mutually exclusive options, only the weight of the heavier option will be added in computing curb weight. Optional equipment weighing less than 3 pounds per item need not be considered.

(3) Where it is expected that more than 33 percent of an engine family will be equipped with an item of optional equipment that can reasonably be expected to influence emissions, then such items of optional equipment shall actually be installed, unless specifically excluded by the Administrator, on all emission-data and durability-data vehicles in the engine family on which the option is intended to be offered in production. Optional equipment that can reasonably be expected to influence emissions are the air conditioner, power steering, power brakes, and other items determined by the Administrator.

(4) Optional equipment that can reasonably be expected to influence emissions and which is utilized on 33 percent or less of the vehicles in the engine family shall not be installed on any vehicle in that engine family unless specifically required under this section.

§ 86.079-25 Maintenance.

(a) *Light-duty vehicles and light-duty trucks.* Paragraph (a) of this section applies to light-duty vehicles and light-duty trucks.

(1) Scheduled maintenance on the engine, emission control system, and fuel system of durability-data vehicles, selected by the Administrator or elected by the manufacturer under § 86.079-24(c)(1), shall be scheduled for performance during durability testing at the same mileage intervals that will be specified in the manufacturer's maintenance instructions furnished to the ultimate purchaser of the motor vehicle. Such maintenance shall be performed, except as provided in paragraph (a)(5)(iii) of this section, only under the following provisions:

(i) Scheduled major engine tuneups to manufacturer's specifications may be performed no more frequently than every 12,500 miles of scheduled driving: *Provided*, That no tuneup may be performed after 45,000 miles of scheduled driving. A scheduled major engine tuneup shall be restricted to paragraph (a)(1)(i)(A) or (B) of this section, and shall be conducted in a manner consistent with service instructions and specifications provided by the manufacturer for use by customer service personnel.

(A) *For gasoline-fueled vehicles*, the following items may be inspected, replaced, cleaned, adjusted, and/or serviced as required:

(*1*) Ignition system.

(*2*) Cold starting enrichment system (includes fast idle speed setting).

(*3*) Curb idle speed and air/fuel mixture.

(*4*) Drive belt tension on engine accessories.

(*5*) Valve lash.

(*6*) Inlet air and exhaust gas control valves.

(*7*) Engine bolt torque.

(*8*) Spark plugs.

(*9*) Fuel filter and air filter.

(*10*) Crankcase emission control system.

(*11*) Fuel evaporative emission control system.

(B) *For Diesel vehicles*, a major engine tuneup shall be restricted to the following:

(*1*) Adjust low idle speed.

(*2*) Adjust valve lash if required.

(*3*) Adjust injector timing.

(*4*) Adjust governor.

(*5*) Clean and service injector tips.

(*6*) Adjust drive belt tension on engine accessories.

(*7*) Check engine bolt torque and tighten as required.

(ii) Change of engine and transmission oil, and change or service of oil filter will be allowed at the same mileage intervals that will be specified in the manufacturer's maintenance instructions.

(iii) Readjustment of the engine idle speed (curb idle and fast idle) may be performed, in addition to adjustment during scheduled major engine tuneups, once during the first 5,000 miles of vehicle operation.

(2)(i) *For gasoline-fueled vehicles*, unscheduled maintenance on the engine, emission control system, and fuel system of durability vehicles may be performed, except as provided in paragraph (a)(5)(i) of this section, only under the following provisions:

(A) Any persistently misfiring spark plug may be replaced, in addition to replacement at scheduled major engine tuneup points.

(B) Readjustment of the engine cold starting enrichment system may be performed if there is a problem of stalling or if there is visible black smoke.

(C) Readjustment of the engine idle-speed (curb idle and fast idle) may be performed, in addition to that performed as scheduled maintenance under paragraph (a)(1) of this section, if the idle speed exceeds the manufacturer's recommended idle speed by 300 r.p.m. or more, or if there is a problem of stalling.

(D) The idle mixture may be reset, other than during scheduled major engine tuneups, only with the advance approval of the Administrator.

(ii) *For Diesel vehicles*, unscheduled maintenance on the engine emission control system, and fuel system of durability-data vehicles may be performed except as provided in paragraph (a)(5)(i) of this section, only under the following provisions:

(A) Injectors may be changed if a persistent misfire is detected.

(B) Readjustment of the engine idle speed (curb idle and fast idle) may be performed in addition to that performed as scheduled maintenance under paragraph (a)(1) of this section, if the idle speed exceeds the manufacturer's recommended idle speed by 300 r.p.m. or more, or if there is a problem of stalling.

(3) An exhaust gas recirculation (EGR) system may be serviced during durability testing only under one of the following provisions:

(i) Manufacturers may schedule service to the EGR system at the scheduled major engine tuneups if an audible and/or visual signal approved by the Administrator alerts the vehicle operator to the need for EGR system maintenance at each of those mileage points. One additional servicing may also be performed as unscheduled maintenance if there is an overt indication of malfunction and if the malfunction or repair of the malfunction does not render the test vehicle unrepresentative of vehicles in use.

(ii) Manufacturers may service the EGR system as unscheduled maintenance a maximum of three times during the 50,000 miles if failure of the EGR system activates an audible and/or visual signal approved by the Administrator which alerts the vehicle operator to the need for EGR system maintenance. One additional servicing may also be performed as unscheduled maintenance if there is an overt indication of malfunction and if the malfunction or repair of the malfunction does not render the test vehicle unrepresentative of vehicles in use.

(iii) Manufacturers may service the EGR system a maximum of three times during the 50,000 miles either at a scheduled major engine tuneup point or as unscheduled maintenance, if an audible and/or visual signal approved by the Administrator alerts the vehicle operator to the need for EGR system maintenance. The signal may be activated either by EGR system failure (unscheduled maintenance) or need for scheduled periodic maintenance. If maintenance is performed, the signal for scheduled periodic maintenance shall be reset. One additional servicing may also be performed as unscheduled maintenance if there is an overt indication of malfunction and if the malfunction or repair of the malfunction does not render the test vehicle unrepresentative of vehicles in use.

(iv) Manufacturers may schedule service to the EGR system at the scheduled major engine tuneup(s) if failure to perform EGR system maintenance is not likely, as determined by the Administrator, to result in an improvement in vehicle performance. One additional servicing may also be performed as unscheduled maintenance if there is an overt indication of malfunction and if the malfunction or repair of the malfunction does not render the test vehicle unrepresentative of vehicles in use.

(4) The catalytic converter may be serviced once during 50,000 miles if an audible and/or visual signal approved by the Administrator alerts the vehicle operator to the need for maintenance. The signal may be activated either by component failure or need for maintenance at a scheduled point.

(5) Any other engine, emission control system, or fuel system adjustment, repair, removal, disassembly, cleaning, or replacement on durability-data vehicles shall be performed only with the advance approval of the Administrator.

(i) In the case of unscheduled maintenance, such approval will be given if the Administrator:

(A) Has made a preliminary determination that part failure or system malfunction, or the repair of such failure or malfunction, does not render the vehicle unrepresentative of vehicles in use, and does not require direct access to the combustion chamber, except for spark plug, fuel injection component, or removable prechamber removal or replacement; and

(B) Has made a determination that the need for maintenance or repairs is indicated by an overt indication of malfunction such as persistent misfiring, vehicle stalling, overheating, fluid leakage, loss of oil pressure, or charge indicator warning. For the evaporative emission control system this overt indication may be indicated by such items as fuel odor or fluid leakage.

(ii) Emission measurements may not be used as a means of determining the need for unscheduled maintenance under paragraph (a)(5)(i)(A) of this section.

(iii) Requests for authorization of scheduled maintenance of emission control-related components not specifically authorized to be maintained by these regulations must be made prior to the beginning of durability testing. The Administrator will approve the performance of such maintenance if the manufacturer makes a satisfactory showing that the maintenance will be performed on vehicles in use.

(6) If the Administrator determines that part failure or system malfunction occurrence and/or repair rendered the vehicle unrepresentative of vehicles in use, the vehicle shall not be used as a durability-data vehicle.

(7) Where the Administrator agrees under § 86.079-26 to a mileage accumulation of less than 50,000 miles for durability testing, he may modify the requirements of this paragraph.

(8) (i) Adjustment of engine idle speed on emission-data vehicles may be performed once before the 6,436-kilometer (4,000-mile) test point. Any other engine, emission control system, or fuel system adjustment, repair, removal, disassembly, cleaning, or replacement on emission-data vehicles shall be performed only with the advance approval of the Administrator.

(ii) Maintenance on emission-data vehicles selected under § 86.079-24 (b)(1)(v) or (b)(1)(vii)(D) and permitted to be tested for purposes of § 86.079-23 (b)(1)(ii) under the provisions of § 86.079-24(b)(1)(vi) may be performed in conjunction with emission control system modifications at the 6,436-kilometer (4,000-mile) test point, and shall be performed in accordance with the maintenance instructions to be provided to the ultimate purchaser required under § 86.079-38.

(iii) Maintenance on those emission-data vehicles selected under § 86.079-24(b)(1)(v) which are not capable of being modified in the field for the purpose of complying with emission standards at an altitude other than intended by the original design may be performed in conjunction with the emission control system modifications at the 6,436-kilometer (4,000-mile) test point, and shall be approved in advance by the Administrator.

(9) Repairs to vehicle components of the durability-data or emission-data vehicle, other than the engine, emission control system, or fuel system, shall be performed only as a result of part failure, vehicle system malfunction, or with the advance approval of the Administrator.

(10) Complete emission tests (see §§ 86.106 through 86.145) are required, unless waived by the Administrator, before and after any vehicle maintenance which may reasonably be expected to affect emissions. These test data shall be air posted to the Administrator within 24 hours (or delivered within 3 working days), after the tests, along with a complete record of all pertinent maintenance, including a preliminary engineering report of any malfunction diagnosis and the corrective action taken. A complete engineering report shall be delivered or air posted to the Administrator within 10 working days after the tests. In addition, all test data and maintenance reports shall be compiled and provided to the Administrator in accordance with § 86.079-23.

(11) The Administrator shall be given the opportunity to verify the existence of an overt indication of part failure and/or vehicle malfunction (e.g., misfiring, stalling, black smoke), or an activation of an audible and/or visual signal, prior to the performance of any maintenance to which such overt indication or signal is relevant under the provisions of this section.

(12) Equipment, instruments, or tools may not be used to identify malfunctioning, maladjusted, or defective engine components unless the same or equivalent equipment, instruments, or tools will be available to dealerships and other service outlets and

(i) Are used in conjunction with scheduled maintenance on such components,

(ii) Are used subsequent to the identification of a vehicle or engine malfunction, as provided in paragraph (a)(5)(i) of this section for durability-data vehicles or paragraph (a)(8)(i) of this section for emission-data vehicles, or

(iii) Unless specifically authorized by the Administrator.

(b) [Reserved]

(c) (1) *Heavy-duty engines.* Paragraph (c) of this section applies to heavy-duty engines.

(2) (i) The scheduled maintenance described in this section may be performed on a durability-data engine pro-

vided the maintenance is requested in the application for certification. Such scheduled maintenance must be specified at the same intervals in the maintenance instructions furnished to the ultimate purchaser of the vehicle in which the engine, represented by the test engine, is installed. (For equivalent dynamometer hours, engine hours, and mileage intervals, see § 86.079–2.) A scheduled major engine servicing shall be restricted to items listed in this subparagraph and shall be conducted in a manner consistent with service instructions and specifications provided by the manufacturer for use by the customer service personnel.

(A) For gasoline-fueled engines, major engine tuneups to manufacturer's specifications may be performed no more frequently than every 375 hours of scheduled dynamometer operation: *Provided*, No tuneups are performed after 1375 hours of scheduled dynamometer operation. The following items may be inspected, replaced, cleaned, adjusted, and/or serviced as required:

(*1*) Ignition system.

(*2*) Cold starting enrichment system (includes fast idle speed setting).

(*3*) Curb idle speed and air/fuel mixture.

(*4*) Drive belt tension on engine accessories.

(*5*) Valve lash.

(*6*) Inlet air and exhaust gas control valves.

(*7*) Engine bolt torque.

(*8*) Spark plugs.

(*9*) Fuel filter and air filter.

(*10*) Crankcase emission control system.

(*11*) Fuel evaporative emission control system.

(B) For Diesel engines one major engine servicing to the manufacturer's specifications may be performed prior to 875 hours (±8 hours) of scheduled dynamometer operation. The following items may be inspected, replaced, cleaned, adjusted, and/or serviced as required:

(*1*) Low idle speed.

(*2*) Drive belt tension.

(*3*) Engine bolt torque.

(*4*) Valve lash.

(*5*) Injection timing.

(*6*) Injector assemblies.

(*7*) Governor settings.

(C) Normal engine servicing such as engine oil change, and oil filter, fuel filter, and air filter cleaning or replacement will be allowed at manufacturer's recommended intervals. If approved in advance by the Administrator, the maintenance for these items may differ from that specified in the manufacturer's maintenance instructions.

(D) Readjustment of the engine low idle speed may be performed once during the first 125 hours of engine operation.

(ii) Unscheduled maintenance may be performed on durability-data engines, except as provided in paragraph (c)(2)(v)(A) of this section, only under the following provisions:

(A) An injector or spark plug may be changed if a persistent misfire is detected.

(B) Readjustment of a gasoline-fueled engine cold-start enrichment system may be performed if there is a problem of stalling or if there is visibile black smoke.

(C) Readjustment of the engine idle speed (curb idle and fast idle) may be performed, in addition to that performed as scheduled maintenance under paragraph (c)(2)(i) of this section, if the idle speed exceeds the manufacturer's recommended idle speed by 300 r.p.m. or more, or if there is a problem of stalling.

(D) The idle mixture may be reset, other than during scheduled major engine tuneups, only with the advance approval of the Administrator.

(iii) Any exhaust gas recirculation (EGR) system may be serviced during durability testing only under one of the following provisions:

(A) Manufacturers may schedule service to the EGR system at the scheduled major engine tuneup if an audible and/or visual signal approved by the Administrator alerts the engine operator to the need for EGR system maintenance at the service point. One additional servicing may also be performed as unscheduled maintenance if there is an overt indication of malfunction and if the malfunction or repair of the malfunction does not render the test engine unrepresentative of engines in use.

(B) Manufacturers may service the EGR system as unscheduled maintenance a maximum of one time during durability testing (1500 hours for gasoline-fuel engines or 1000 hours for Diesel engines) if failure of the EGR system activates an audible and/or visual signal approved by the Administrator which alerts the engine operator to the need for EGR system maintenance. One additional servicing may also be performed as unscheduled maintenance if there is an overt indication of malfunction and if the malfunction or repair of the malfunction does not render the test engine unrepresentative of engines in use.

(C) Manufacturers may service the EGR system a maximum of three times during durability testing (1500 hours for gasoline-fueled engines or 1000 hours for Diesel engines) either at a scheduled major engine tuneup point or as unscheduled maintenance, if an audible and/or visual signal approved by the Administrator alerts the engine operator to the need for EGR system maintenance. The signal may be activated either by EGR system failure (unscheduled maintenance) or need for scheduled periodic maintenance. If maintenance is performed, the signal for scheduled periodic maintenance shall be reset. One additional servicing may also be performed as unscheduled maintenance if there is an overt indication of malfunction and if the malfunction or repair of the malfunction does not render the test engine unrepresentative of engines in use.

(D) Manufacturers may schedule service to the EGR system at the scheduled major engine tuneup(s) if failure to perform EGR system maintenance is not likely, as determined by the Administrator, to result in an improvement in engine performance. One additional servicing may also be performed as unscheduled maintenance if there is an overt indication of malfunction and if the malfunction or repair of the malfunction does not render the test engine unrepresentative of engines in use.

(iv) The catalytic converter may be serviced once during durability testing (1500 hours for gasoline-fueled engines or 1000 hours for Diesel engines) if an audible and/or visual signal approved by the Administrator alerts the engine operator to the need for maintenance. The signal may be activated either by component failure or need for maintenance at a scheduled point.

(v) Any other engine, emission control system, or fuel system adjustment, repair, removal, disassembly, cleaning, or replacement on durability-data engines shall be performed only with the advance approval of the Administrator.

(A) In the case of unscheduled maintenance such approval will be given if the Administrator:

(*1*) Has made a preliminary determination that part failure or system malfunction, or the repair of such failure or malfunction, does not render the engine unrepresentative of engines in use, and does not require direct access to the combustion chamber, except for spark plug, fuel injection component, or removable prechamber removal or replacement; and,

(*2*) Has made a determination that the need for maintenance or repairs is indicated by an overt indication of malfunction such as persistent misfiring, engine stalling, overheating, fluid leakage, loss of oil pressure, excessive fuel consumption or excessive power loss.

(B) Emission measurements may not be used as a means of determining the need for unscheduled maintenance under paragraph (c)(2)(v)(A)(1) of this section.

(C) Requests for authorization of scheduled maintenance of emission-control related components not specifically authorized to be maintained by these regulations must be made prior to the beginning of durability testing. The Administrator will approve the performance of such maintenance if the manufacturer makes a satisfactory showing that the maintenance will be performed on engines in use.

(vi) If the Administrator determines that part failure or system malfunction occurrence and/or repair rendered the engine unrepresentative of engines in use, the engine shall not be used as a durability-data engine.

(3)(i) Scheduled maintenance on emission-data engines is limited to the adjustment of idle speed once before the 125-hour test point, provided the idle speed is outside the manufacturer's specifications.

(ii) Any other engine, emission control system, or fuel system, adjustment, repair, removal, disassembly, cleaning, servicing, or replacement shall be performed only with the advance approval of the Administrator.

(4) [Reserved]

(5) (i) Complete emission tests (see Subparts D or H of this part for gasoline-fueled engines and Subparts D and I, or I and J of this part for Diesel engines) are required, unless waived by the Administrator, before and after:

(A) Scheduled maintenance approved for durability-data engines, except maintenance performed under § 86.079–25(c)(2)(i)(c);

(B) Unscheduled maintenance which may reasonably be expected to affect emissions.

(ii) The tests before and after scheduled maintenance, which are performed on durability-data engines prior to 117 hours, are waived. The test before scheduled maintenance, which is performed on durability-data engines after 117 hours and prior to 133 hours, is waived. The after-maintenance test must be run and the results used in the deterioration factor calculation in accordance with § 86.079–28.

(iii) The idle speed reset and any scheduled maintenance on the emission-data engine shall be performed prior to the 125-hour test. The before-maintenance and after-maintenance tests associated with idle speed reset and scheduled maintenance on the emission-data engine are waived.

(iv) Test data required by this paragraph shall be air posted to the Administrator within 72 hours of test completion (or delivered within 5 working days), along with a complete record of all pertinent maintenance.

(v) When unscheduled maintenance is approved, a preliminary engineering report, unless waived by the Administrator, shall be air posted within 72 hours (or delivered within 5 working days). A final engineering report shall be delivered or air posted within 10 working days after the completion of the emission tests. The Administrator may approve an extension of the time requirements for the final engineering report.

(vi) All test data, maintenance reports, and required engineering reports shall be compiled and provided to the Administrator in accordance with § 86.079–23.

(6) The Administrator shall be given the opportunity to verify the existence of an overt indication of part failure and/or engine malfunction (e.g., misfiring, stalling).

(7) Equipment, instruments, or tools may not be used to identify malfunctioning, maladjusted, or defective engine components unless the same or equivalent equipment, instruments, or tools will be available to dealerships and other service outlets, and:

(i) Are used in conjunction with scheduled maintenance on such components;

(ii) Are used subsequent to the identification of an engine failure or malfunction, as provided in paragraph (c)(2)(v)(A) of this section for durability-data engines or paragraph (c)(3) of this section for emission-data engines; or,

(iii) Unless specifically authorized by the Administrator.

8. Section 86.079–26 is revised to read as follows:

§ 86.079–26 Mileage and service accumulation; emission measurements.

(a) (1) Paragraph (a) of this section applies to light-duty vehicles and light-duty trucks.

(2) The procedure for mileage accumulation will be the Durability Driving Schedule as specified in Appendix IV to this part. A modified procedure may also be used if approved in advance by the Administrator. Except with the advance approval of the Administrator, all vehicles will accumulate mileage at a measured curb weight which is within 100 pounds of the estimated curb weight. If the loaded vehicle weight is within 100 pounds of being included in the next higher inertia weight class as specified in § 86.125, the manufacturer may elect to conduct the respective emission tests at the higher loaded vehicle weight. Mileage will be accumulated on four-wheel drive vehicles in their normal on-highway mode of operation.

(3) Emission-data vehicles.

(i) *Gasoline-fueled.* (A) Each gasoline-fueled emission-data vehicle shall be driven 4000 miles with all emission control systems installed and operating. Complete exhaust emission tests shall be conducted at zero miles and 4000 miles on those vehicles selected under § 86.079–24(b)(1)(ii) through (b)(1)(v). Complete exhaust and evaporative emission tests shall be conducted at zero miles and 4000 miles on those vehicles selected under § 86.079–24(b)(1)(vii). The manufacturer may at his option test the vehicles selected under § 86.079–29(b)(1)(vii) up to three times at the 4000-mile test point as long as the ±250-mile test tolerance is adhered to. The Administrator may determine under § 86.079–24(f) that no testing is required.

(B) The emission-data vehicle(s) selected for testing under § 86.079–24(b)(1)(v) or (b)(1)(vii)(D) shall be driven 6436 kilometers (4000 miles) at any altitude. Emission tests shall be conducted at zero kilometers (zero miles) at any altitude and 6436 kilometers (4000 miles) under high altitude conditions.

(C) The emission-data vehicle(s) selected for testing under § 86.079–24(b)(1)(v) or (b)(1)(vii)(D) and permitted to be tested for purposes of § 86.079–23(b)(1)(ii) under the provisions of § 86.079–24(b)(1)(vi) shall be driven 6436 kilometers (4000 miles) at low altitude. Emission tests shall be conducted at zero kilometers (zero miles) at low altitude and 6436 kilometers (4000 miles) under both low and high altitude conditions. For the purposes of this subparagraph, low altitude means any elevation less than 549 meters (1800 feet).

(ii) *Diesel.* (A) Each Diesel emission-data vehicle shall be driven 6436 kilometers (4000 miles) with all emission control systems installed and operating. Emission tests shall be conducted at zero kilometers (zero miles) and 6436 kilometers (4000 miles).

(B) The emission-data vehicle(s) selected for testing under § 86.079–24(b)(1)(v) shall be driven 6436 kilometers (4000 miles) at any altitude. Emission tests shall be conducted at zero kilometers (zero miles) at any altitude and 6436 kilometers (4000 miles) under high altitude conditions.

(C) The emission-data vehicle(s) selected for testing under § 86.079–24(b)(1)(v) and permitted to be tested for purposes of § 86.079–23(b)(1)(ii) under the provisions of § 86.079–24(b)(1)(vi) shall be driven 6436 kilometers (4000 miles) at low altitude. Emission tests shall be conducted at zero kilometers (zero miles) at low altitude and 6436 kilometers (4000 miles) under both low and high altitude conditions. For the purpose of this subparagraph low altitude means any elevation less than 549 meters (1800 feet).

(4) Durability-data vehicles.

(i) *Gasoline-fueled.* Each gasoline-fueled durability-data vehicle selected by the Administrator or elected by the manufacturer under § 86.079–24(c)(1) shall be driven, with all emission control systems installed and operating, for 50,000 miles or such lesser distance as the Administrator may agree to as meeting the objective of this procedure. Complete exhaust emission tests shall be made on all durability-data vehicles selected by the Administrator or elected by the manufacturer under § 86.079–24(c) at the following mileage points: 0; 5000; 10,000; 15,000; 20,000; 25,000; 30,000; 35,000; 40,000; 45,000; 50,000. The Administrator may determine under § 86.079–24(f) that no testing is required.

(ii) *Diesel.* Each Diesel durability-data vehicle shall be driven, with all emission control systems installed and operating, for 50,000 miles or such lesser distance as the Administrator may agree to as meeting the objectives of this procedure. Complete emission tests (see §§ 86.106 through 86.145) shall be made at the following mileage points: 0; 5,000; 10,000; 15,000; 20,000; 25,000; 30,000; 35,000; 40,000; 45,000; and 50,000.

(5) All tests required by this subpart to be conducted after every 5,000 miles of driving of durability-data vehicles and 4,000 miles for emission-data vehicles must be conducted at any accumulated mileage within 250 miles of each of those test points.

(6) (i) The results of each emission test shall be supplied to the Administrator immediately after the test. The manufacturer shall furnish to the Administrator explanation for voiding any test. The Administrator will determine if voiding the test was appropriate based upon the explanation given by the manufacturer for the voided test. If a manufacturer conducts multiple tests at any test point at which the data are intended to be used in the calculation of the deterioration factor, the number of tests must be the same at each point and may not exceed three valid tests. Tests between test points may be conducted as required by the Administrator. Data from all tests (including voided tests) shall be air posted to the Administrator within 24 hours (or delivered within 3 working days). In addition, all test data

shall be compiled and provided to the Administrator in accordance with § 86.-079–23. Where the Administrator conducts a test on durability-data vehicle at a prescribed test point, the results of that test will be used in the calculation of the deterioration factor.

(ii) The results of all emission tests shall be rounded, using the "Rounding Off Method" specified in ASTM E 29–67, to the number of places to the right of the decimal point indicated by expressing the emission standards of this subpart to three significant figures.

(7) Whenever the manufacturer proposes to operate and test a vehicle which may be used for emission or durability data, he shall provide the zero-mile test data to the Administrator and make the vehicle available for such testing under § 86.079–29 as the Administrator may require before beginning to accumulate mileage on the vehicle. Failure to comply with this requirement will invalidate all test data submitted for this vehicle.

(8) Once a manufacturer begins to operate an emission-data or durability-data vehicle, as indicated by compliance with paragraph (a)(7) of this section, he shall continue to run the vehicle to 4,000 miles or 50,000 miles, respectively, and the data from the vehicle will be used in the calculations under § 86.079–28. Discontinuation of a vehicle shall be allowed only with the written consent of the Administrator.

(9)(i) The Administrator may elect to operate and test any test vehicle during all or any part of the mileage accumulation and testing procedure. In such cases, the manufacturer shall provide the vehicle(s) to the Administrator with all information necessary to conduct this testing.

(ii) The test procedures in §§ 86.106 through 86.145 will be followed by the Administrator. The Administrator will test the vehicles at each test point. Maintenance may be performed by the manufacturer under such conditions as the Administrator may prescribe.

(iii) The data developed by the Administrator for the engine-system combination shall be combined with any applicable data supplied by the manufacturer on other vehicles of that combination to determine the applicable deterioration factors for the combination. In the case of a significant discrepancy between data developed by the Administrator and that submitted by the manufacturer, the Administrator's data shall be used in the determination of deterioration factors.

(10) Emission testing of any type with respect to any certification vehicle other than that specified in this subpart is not allowed except as such testing may be specifically authorized by the Administrator.

(11) This section does not apply to testing conducted to meet the requirements of § 86.079–23(b)(2).

(b)(1) Paragraph (b) of this section applies to heavy-duty engines.

(2)(i) For gasoline-fueled engines, the dynamometer service accumulation schedule will consist of several operating conditions which give the percent loads and the modes as specified in the following chart. The percentage of time in each mode must be held within the limits specified. The maximum observed torque for each mode in the service accumulation cycle must be determined at the rpm at which the mode is being conducted. The percent load for that mode will be determined from the maximum torque at the rpm at which the mode is being conducted.

Mode	Observed torque (percentage of maximum observed)	Percentage of time
Idle	Idle	23 (22 to 24).
CT	CT	14 (13 to 15).
PTD	10	6 (5 to 7).
Cruise	25	31 (30 to 32).
PTA	55	15 (14 to 16).
FL	90	11 (10 to 12).

(ii) The equivalent control parameter for engine loading will be manifold vacuum, manifold pressure, or torque. Usage of one of the three parameters will require approval in advance by the Administrator. The control parameter values that correspond to the appropriate percent loads as specified in the emission test cycle will be initially determined at the zero-hour point or after an appropriate break-in procedure. The control parameter values determined initially will be used for the entire service accumulation schedule. If at any time during the service accumulation, the 90 percent torque value cannot be attained, the engine shall be operated at wide-open throttle.

(iii) The average speed shall be between 1,650 and 1,700 rpm. Subject to the requirements as to average speed, there must be operation at speeds in excess of 3,200 rpm (but not in excess of governed speed for governed engines or rated speed for non-governed engines) for a cumulative maximum of 0.5 percent of the actual cycle time, excluding time in transient conditions. Maximum cycle time shall be 15 minutes. A cycle approved in advance by the Administrator shall be used.

(3) (i) For Diesel engines, the following criteria must be met before service accumulation can begin. Failure to comply with these requirements shall invalidate all test data submitted for an engine.

(A) Each engine shall produce at least 95 percent of the maximum horsepower, corrected to rating conditions, at 95 to 100 percent of the rated speed.

(B) The fuel rate at maximum horsepower shall be within manufacturer's specifications.

(ii) During service accumulation, hours can be credited toward the required service accumulation hours when the following criteria are met. If these criteria cannot be met, engine operation shall be discontinued and the Administrator shall be notified immediately. (Adjustments to the fuel rate can be approved under the provisions of § 86.079–25.)

(A) Each engine shall produce at least 95 percent of the maximum horsepower, at 95 to 100 percent of the rated speed, observed at the zero-hour point. Horsepower values shall be corrected to the rating conditions.

(B) The engine shall be operated at 75 percent of the inlet and exhaust restrictions specified in § 86.879–8 except that the tolerance will be ±3 inches of water and ±0.5 inch of Hg respectively.

(C) During each emission test the inlet and exhaust restrictions shall be as specified in § 86.879–8.

(4) If a break-in procedure is used the procedure must be the same as recommended to the ultimate purchaser. Prior approval by the Administrator is required for use of any break-in procedure. The hours accumulated during the break-in procedure will not be counted as part of the service accumulation.

(5) Emission-data engines: Each emission-data engine shall be operated for 125 hours with all emission control systems installed and operating. An emission test shall be conducted at 125 hours. A zero-hour emission may be performed after the engine has been approved by the Administrator to begin service accumulation. Evaporative emission controls need not be connected provided normal operating conditions are maintained in the engine induction system.

(6) Durability-data engines: Each gasoline-fueled durability-data engine shall be operated, with all emission control systems installed and operating, for 1,500 hours. Each Diesel durability-data engine shall be operated for 1,000 hours. Emission measurement, as prescribed, shall be made at 125-hour intervals beginning at 125 hours of operation. A zero-hour emission test may be performed after the engine has been approved by the Administrator to begin service accumulation. Evaporative emission controls need not be connected provided normal operating conditions are maintained in the engine induction system.

(7) All tests required by this subpart to be conducted after 125 hours of operation or at any multiple of 125 hours may be conducted at any accumulated number of hours within 8 hours of 125 hours or the appropriate multiple of 125 hours respectively.

(8)(i) Daata from all emission tests (including voided tests) shall be air posted to the Administrator within 72 hours (or delivered within 5 working days). The manufacturer shall furnish to the Administrator an explanation for voiding any test. The Administrator will determine if voiding the test was appropriate based upon the explanation given by the manufacturer for the voided test. If a manufacturer conducts multiple tests at any test point at which the data are intended to be used in the calculation of the deterioration factor, the number of tests must be the same at each point and may not exceed 3 valid tests. Tests between test points may be conducted as required by the Administrator. In addition, all test data shall be compiled and provided to the Administrator in accordance with § 86.079–23. Where the Administrator conducts a test on a durability-data engine at a prescribed test point, the results of that test will

be used in the calculation of the deterioration factor.

(ii) The results of all emission tests shall be recorded and reported to the Administrator using two places to the right of the decimal point. These numbers shall be rounded in accordance with the "Rounding Off Method" specified in ASTM E 29–67.

(9) Whenever the manufacturer proposes to operate and test an engine which may be used for emission or durability data, he shall provide such information concerning components used on the engine as the Administrator may require and make the engine available for such testing under § 86.079–29 as the Administrator may require, before beginning to accumulate hours on the engine. Failure to comply with this requirement will invalidate all test data later submitted for this engine.

(10) Once a manufacturer begins to operate an emission-data or durability-data engine, as indicated by compliance with paragraph (b)(9) of this section, he shall continue to run any emission-data engine to 125 hours, any gasoline-fueled durability-data engine to 1,500 hours, and any Diesel durability-data engine to 1000 hours. The data from the engine will be used in the calculations under § 86.345. Discontinuation of an engine shall be allowed only with the prior written consent of the Administrator.

(11)(i) The Administrator may elect to operate and test any test engine during all or any part of the service accumulation and testing procedure. In such cases the manufacturer shall provide the engine(s) to the Administrator with all information necessary to conduct the testing.

(ii) The test procedures (Subparts D or H of this part for gasoline-fueled engines, and Subparts D, I, or J of this part for Diesel engines) will be followed by the Administrator. The Administrator will test the engines at each test point. Maintenance may be performed by the manufacturer under such conditions as the Administrator may prescribe.

(iii) The data developed by the Administrator for the engine-system combination shall be combined with any applicable data supplied by the manufacturer on other engines of that combination to determine the applicable deterioration factors for the combination. In the case of a significant discrepancy between data developed by the Administrator and that submitted by the manufacturer, the Administrator's data shall be used in the determination of deterioration factors.

(12) Emission testing of any type with respect to any certification engine other than that specified in this subpart is not allowed except as such testing may be specifically authorized by the Administrator.

9. New §§ 86.079–27 through 86.079–29 are added and read as follows:

§ 86.079–27 Special test procedures.

(a) For light-duty vehicles and light-duty trucks the Administrator may, on the basis of a written application therefore by a manufacturer, prescribe test procedures, other than those set forth in this part, for any motor vehicle which he determines is not susceptible to satisfactory testing by the procedures set forth herein or in Subpart B of this part.

(b) For heavy-duty engines:

(1) The Administrator, may on the basis of a written application therefore by a manufacturer, prescribe test procedures, other than those set forth in this subpart, for any motor-vehicle engine which he determines is not susceptible to satisfactory testing by the procedures set forth herein or in Subparts D and I of this part.

(2) If the manufacturer does not submit a written application for use of special test procedures but the Administrator determines that a motor-vehicle engine is not susceptible to satisfactory testing by the procedures set forth herein, the Administrator will reject the applicable portions of the application. The Administrator shall notify the manufacturer in writing and set forth the reasons for such rejection in accordance with the provisions of § 86.079–22(c).

§ 86.079–28 Compliance with emission standards.

(a)(1) Paragraph (a) of this section applies to light-duty vehicles and light-duty trucks.

(2) The applicable exhaust and fuel evaporative emission standards of this subpart apply to the emissions of vehicles for their useful life.

(3) Since it is expected that emission control efficiency will change with mileage accumulation on the vehicle, the emission level of a vehicle which has accumulated 50,000 miles will be used as the basis for determining compliance with the standards.

(4) The procedure for determining compliance of a new motor vehicle with exhaust emission standards is as follows:

(i) Separate emission deterioration factors shall be determined from the exhaust emission results of the durability-data vehicle(s) for each engine-system combination. A separate factor shall be established for exhaust HC, exhaust CO, and exhaust NO_x for each engine-system combination. A separate evaporative emission deterioration factor shall be determined for each evaporative emission family-evaporative emission control system combination from the testing conducted by the manufacturer.

(A) The applicable results to be used in determining the exhaust emission deterioration factors for each engine-system combination shall be:

(1) All valid exhaust emission data from the tests required under § 86.079–26(a)(4) except the zero-mile tests. These shall include the official test results, as determined in § 86.079–29 for all tests conducted on all durability-data vehicles of the combination selected under § 86.079–24(c) (including all vehicles elected to be operated by the manufacturer under § 86.079–24(c)(1)(ii)).

(2) All exhaust emission data from the tests conducted before and after the scheduled maintenance provided in § 86.079–25.

(3) All exhaust emission data from tests required by maintenance approved under § 86.079–25, in those cases where the Administrator conditioned his approval for the performance of such maintenance on the inclusion of such data in the deterioration factor calculation.

(B) All applicable exhaust emission results shall be plotted as a function of the mileage on the system, rounded to the nearest mile, and the best fit straight lines, fitted by the method of least squares, shall be drawn through all these data points. The interpolated 4,000- and 50,000-mile points on this line must be within the standards provided in § 86.078–8 or § 86.079–9, as applicable, or the data will not be acceptable for use in calculation of a deterioration factor, unless no applicable data point exceeded the standard. An exhaust emission deterioration factor shall be calculated for each engine-system combination as follows:

Factor = Exhaust emissions interpolated to 50,000 miles ÷ exhaust emissions interpolated to 4,000 miles.

These interpolated values shall be carried out to a minimum of four places to the right of the decimal point before dividing one by the other to determine the deterioration factor. The results shall be rounded to three places to the right of the decimal point in accordance with ASTM E 29–67.

(C) An evaporative emissions deterioration factor shall be determined from the testing conducted as described in § 86.079–21(b)(4)(ii), for each evaporative emission family-evaporative emission control system combination to indicate the evaporative emission level at 50,000 miles relative to the evaporative emission level at 4,000 miles as follows:

Factor = Evaporative emission level at 50,000 miles minus the evaporative emission level at 4,000 miles.

The factor shall be established to a minimum of two places to the right of the decimal.

(ii)(A) The official exhaust emission test results for each emission-data vehicle at the 4,000-mile test point shall be multiplied by the appropriate deterioration factor: *Provided*, That if a deterioration factor as computed in paragraph (a)(4)(i)(B) of this section is less than one, that deterioration factor shall be one for the purposes of this paragraph.

(B) The official evaporative emission test results for each evaporative emission-data vehicle at the 4,000-mile test point shall be adjusted by addition of the appropriate deterioration factor: *Provided*, That if a deterioration factor as computed in paragraph (a)(4)(i)(C) of this section is less than zero, that deterioration factor shall be zero for the purposes of this paragaph.

(iii) The emissions to compare with the standard shall be the adjusted emissions of paragraph (a)(4)(ii)(A) and (B) of this section for each emission-data vehicle. Before any emission value

is compared with the standard, it shall be rounded, in accordance with ASTM E 29–67, to two significant figures. The rounded emission values may not exceed the standard.

(iv) Every test vehicle of an engine family must comply with the exhaust emission standards, as determined in paragraph (a)(4)(iii) of this section, before any vehicle in that family may be certified.

(v) Every test vehicle of an evaporative emission family must comply with the evaporative emission standards, as determined in paragraph (a)(4)(iii) of this section, before any vehicle in that family may be certified.

(b) (1) Paragraph (b) of this section applies to heavy-duty engines.

(2) The exhaust emission standards for gasoline-fueled engines in § 86.079–10 or for Diesel engines in § 86.079–11 apply to the emissions of engines for their useful life.

(3) Since emission control efficiency decreases with the accumulation of hours on the engine, the emission level of a gasoline-fueled engine which has accumulated 1,500 hours of dynamometer operation or a Diesel engine which has accumulated 1,000 hours of dynamometer operation will be used as the basis for determining compliance with the standards.

(4) The procedure for determining compliance of a new engine with exhaust emission standards is as follows:

(i) Separate emission deterioration factors shall be determined from the emission results of the durability-data engines for each engine-system combination. Separate factors shall be established for HC, CO, and for the combined emissions of HC and NOx. For Diesel engines, separate factors shall also be established for the acceleration mode (designated as "A"), the lugging mode (designated as "B") and the peak opacity (designated as "C").

(A) The applicable results to be used in determining the deterioration factors for each combination shall be:

(*1*) All valid emission data from the tests required under § 86.079–26(b). These shall include the official test results, as determined in § 86.079–29, for all tests conducted on all gasoline-fueled durability-data engines of the combination selected under § 86.079–24(c)(2) or on all Diesel durability-data engines of the combination selected under § 86.079–24(c)(3) (including all engines elected to be operated by the manufacturer under § 86.079–24(c)(2)(iii) for gasoline-fueled engines or under § 86.079–24(c)(3)(ii) for Diesel engines).

(*2*) All emission data from the tests conducted before and after maintenance provided in § 86.079–25(c)(2)(i)(A) for gasoline-fueled engines or in § 86.079–25(c)(2)(i)(B) for Diesel engines.

(*3*) All emission data from the tests conducted before and after maintenance provided in § 86.079–25(c)(2)(v)(C) for Diesel engines if emission tests were conducted.

(B) All applicable emission results for (1) HC, (2) CO, (3) HC+NOx, (4) acceleration smoke ("A"), (5) lugging smoke ("B"), and (6) peak smoke ("C") shall be plotted as a function of durability hours which shall be consistently rounded to the nearest hour. Emission data shall have two figures to the right of the decimal. The best fit straight lines, fitted by the method of least squares, shall be drawn through these data points. The interpolated 125-hour and 1,500-hour points for gasoline-fueled engines or the 1,000-hour point for Diesel engines on each line, rounded to whole numbers in accordance with ASTM E 29–67, must be within the standards specified in § 86.079–10 for gasoline-fueled engines or in § 86.079–11 for Diesel engines or the data shall not be used in the calculation of a deterioration factor, unless no applicable data points exceed the standards.

(C) The interpolated values shall be used to calculate a deterioration factor as follows:

Factor = Exhaust emissions interpolated to 1,500 hours for gasoline-fueled engines or to 1,000 hours for Diesel engines minus the exhaust emissions interpolated to 125 hours. (Negative deterioration factors shall be considered zero.)

(ii) The appropriate deterioration factor, carried out to two places to the right of the decimal point, shall be added to the exhaust emission test results, carried out to two places to the right of the decimal point, for each emission-data engine.

(iii) The emission values to compare with the standards shall be the adjusted emission values of paragraph (b)(4)(ii) of this section rounded to two significant figures in accordance with ASTM E 29–67 for each emission-data engine.

(iv) Every test engine of engine family must comply with all applicable standards, as determined in paragraph (b)(4)(iii) of this section, before any engine in that family will be certified.

§ 86.079–29 Testing by the Administrator.

(a) (1) Paragraph (a) of this section applies to light-duty vehicles and light-duty trucks.

(2) The Administrator may require that any one or more of the test vehicles be submitted to him, at such place or places as he may designate, for the purposes of conducting emissions tests. The Administrator may specify that he will conduct such testing at the manufacturer's facility, in which case instrumentation and equipment specified by the Administrator shall be made available by the manufacturer for test operations. Any testing conducted at a manufacturer's facility pursuant to this paragraph shall be scheduled by the manufacturer as promptly as possible.

(3) (i) Whenever the Administrator conducts a test on a test vehicle, the results of that test shall, unless subsequently invalidated by the Administrator, comprise the official data for the vehicle at the prescribed test point and the manufacturer's data for that prescribed test point shall not be used in determining compliance with emission standards.

(ii) Whenever the Administrator does not conduct a test on a test vehicle at a test point, the manufacturer's test data will be accepted as the official data for that test point: *Provided*, That if the Administrator makes a determination based on testing under paragraph (a)(2) of this section that there is a lack of correlation between the manufacturer's test equipment and the test equipment used by the Administrator, no manufacturer's test data will be accepted for purposes of certification until the reasons for the lack of correlation are determined and the validity of the data is established by the manufacturer; *And further provided*, That if the Administrator has reasonable basis to believe that any test data submitted by the manufacturer is not accurate or has been obtained in violation of any provisions of this part, the Administrator may refuse to accept that data as the official data pending retesting or submission of further information. If the manufacturer conducts more than one test on a vehicle, as authorized under § 86.079–26(a)(3)(i)(A), the data from the last test in that series of tests on that vehicle will constitute the official data.

(iii) (A) The emission-data vehicle presented to the Administrator for testing shall be calibrated within the production tolerances applicable to the manufacturer's specifications to be shown on the vehicle label (see § 86.079–35(a)(1)(iii)(D)) as specified in the application for certification. If the Administrator determines that a vehicle is not within such tolerances, the vehicle shall be adjusted at the facility designated by the Administrator prior to the test and an engineering report shall be submitted to the Administrator describing the corrective action taken. Based on the engineering report, the Administrator will determine if the vehicle shall be used as an emission-data vehicle.

(B) If the Administrator determines that the test data developed on an emission-data vehicle under paragraph (a)(3)(i) of this section would cause that vehicle to fail due to excessive 4,000 mile emissions or by application of the appropriate deterioration factor, then the following procedure shall be observed:

(*1*) The manufacturer may request a retest. Before the retest, the vehicle may be readjusted to manufacturer's specifications, if these adjustments were made incorrectly prior to the first test, and other maintenance or repairs may be performed in accordance with § 85.079–25. All work on the vehicle shall be done at such location and under such conditions as the Administrator may prescribe.

(*2*) The vehicle will be retested by the Administrator and the results of this test shall comprise the official data for the emission-data vehicle.

(iv) If sufficient durability data are not available at the time of any emission test conducted under paragraph (a)(2) of this section to enable the Administrator to determine whether an

emission-data vehicle would fail, the manufacturer may request a retest in accordance with the provisions of paragraphs (a)(3)(iii) (A) and (B) of this section. If the manufacturer does not promptly make such request, he shall be deemed to have waived the right to a retest. A request for retest must be made before the manufacturer removes the vehicle from the test premises.

(b) (1) Paragraph (b) of this section applies to heavy-duty engines.

(2) The Administrator may require that any one or more of the test engines be submitted to him, at such place or places as he may designate, for the purpose of conducting emissions tests. The Administrator may specify that he will conduct such testing at the manufacturer's facility, in which case instrumentation and equipment specified by the Administrator shall be made available by the manufacturer for test operations. Any testing conducted at a manufacturer's facility pursuant to this paragraph shall be scheduled by the manufacturer as promptly as possible.

(3) (i) Whenever the Administrator conducts a test on a test engine the results of that test, unless subsequently invalidated by the Administrator, shall comprise the official data for the engine at that prescribed test point and the manufacturer's data for that prescribed test point shall not be used in determining compliance with emission standards.

(ii) Whenever the Administrator does not conduct a test on a test engine at a test point, the manufacturer's test data will be accepted as the official data for that test point: *Provided*, That if the Administrator makes a determination based on testing under paragraph (b)(2) of this section that there is a lack of correlation between the manufacturer's test equipment and the test equipment used by the Administrator, no manufacturer's test data will be accepted for purposes of certification until the reasons for the lack of correlation are determined and the validity of the data is established by the manufacturer: *And further provided*, That if the Administrator has reasonable basis to believe that any test data submitted by the manufacturer is not accurate or has been obtained in violation of any provision of this part, the Administrator may refuse to accept that data as the official data pending retesting or submission of further information.

(iii) (A) The emission-data engine presented to the Administrator for testing shall be calibrated within the production tolerances applicable to the manufacturer's specifications to be shown on the engine label (see § 86.079-35(a)(2)(iii)) as specified in the application for certification. If the Administrator determines that an engine is not within such tolerances, the engine shall be adjusted at the facility designated by the Administrator prior to the test and an engineering report shall be submitted to the Administrator describing the corrective action taken. Based on the engineering report the Administrator will determine if the engine shall be used as an emission-data engine.

(B) If the Administrator determines that the test data developed under paragraph (b)(3)(iii)(A) of this section would cause the emission-data engine to fail due to excessive 125-hour emission values or by the application of the appropriate deterioration factor, then the following procedure shall be observed.

(*1*) The manufacturer may request a retest. Before the retest, the engine may be readjusted to manufacturer's specifications if these adjustments were made incorrectly prior to the first test, and other maintenance or repairs may be performed in accordance with § 86.079-25. All work on the engine shall be done at such location and under such conditions as the Administrator may prescribe.

(2) The engine will be retested by the Administrator and the results of this test shall comprise the official data for the emission-data engine.

(iv) If sufficient durability data are not available at the time of any emission test conducted under paragraph (b)(2) of this section to enable the Administrator to determine whether an emission-data engine would fail, the manufacturer may request a retest in accordance with the provisions of paragraphs (b)(3)(iii)(B) (*1*) and (2) of this section. If the manufacturer does not promptly make such request, he shall be deemed to have waived the right to a retest. A request for retest must be made before the manufacturer removes the engine from the test premises.

10. Section 86.079-30 is revised to read as follows:

§ 86.079-30 Certification.

(a) (1) If, after a review of the test reports and data submitted by the manufacturer, data derived from any inspection carried out under § 86.078-7(c) and any other pertinent data or information, the Administrator determines that a test vehicle(s) (or test engine(s)) meets the requirements of the Act and of this subpart, he will issue a certificate of conformity with respect to such vehicle(s) (or engine(s)) except in cases covered by paragraph (c) of this section. If applicable, the certificate will state which vehicles are certified for sale at high altitude.

(2) Such certificate will be issued for such period not to exceed one model year as the Administrator may determine and upon such terms as he may deem necessary to assure that any new motor vehicle (or new motor vehicle engine) covered by the certificate will meet the requirements of the Act and of this part. Each such certificate shall contain the following language:

This certificate covers only those new motor vehicles (or new motor vehicle engines) which conform, in all material respects, to the design specifications that applied to those vehicles (or engines) described in the application for certification and which are produced during the ____ model year production period of the said manufacturer, as defined in 40 CFR 86.079-2.

It is a term of this certificate that the manufacturer shall consent to all inspections described in 40 CFR 86.078-7(c) which concern either the vehicle (or engine) certified, or any production vehicle (or production engine) covered by this certificate, or any production vehicle (or production engine) which when completed will be claimed to be covered by this certificate. Failure to comply with all the requirements of § 86.078-7(c) with respect to any such vehicle (or engine) may lead to revocation or suspension of this certificate as specified in 40 CFR § 86.079-30(c). It is also a term of this certificate that this certificate may be revoked or suspended for the other reasons stated in § 86.079-30 (c) or (d).

(3) One such certificate will be issued for each engine family and will certify compliance with no more than one set of applicable standards except that for gasoline-fueled light-duty vehicles and light-duty trucks, one such certificate will be issued for each engine family-evaporative emission family combination and will certify compliance with no more than one set of applicable standards.

(4) A violation of section 203(a)(1) of the Clean Air Act occurs when any manufacturer sells, offers for sale, introduces or delivers for introduction into commerce any light-duty vehicle or light-duty truck, subject to the regulations under the Act, which is not covered by a certificate of conformity at high altitude issued under this part:

(i) At a designated high-altitude location, unless such manufacturer has substantial reason to believe that such motor vehicle will not be sold to an ultimate purchaser for principal use at a designated high-altitude location; or,

(ii) At an other than designated high-altitude location, when such manufacturer has reason to believe that such motor vehicle is intended by the ultimate purchaser to be used principally at a designated high-altitude location.

(5) For the purpose of paragraph (a) of this section, "designated high-altitude location" is any county which has substantially all of its area located above 1,219 meters (4,000 feet) and which is identified below.

COUNTIES LOCATED SUBSTANTIALLY ABOVE 1,219 METERS (4,000 FEET) IN ELEVATION

STATE OF ARIZONA	
Apache	Navajo
STATE OF COLORADO	
Adams	Jefferson
Alamosa	Lake
Arapahoe	La Plata
Archuleta	Larimer
Boulder	Las Animas
Chaffee	Lincoln
Clear Creek	Mesa
Conejos	Mineral
Costilla	Moffat
Crowley	Montezuma
Custer	Montrose
Dolores	Morgan
Delta	Ouray
Denver	Park
Douglas	Pitkin
Eagle	Pueblo
Elbert	Rio Blanco
El Paso	Rio Grande
Fremont	Routt
Garfield	Saguache
Gilpin	San Juan
Grant	San Miguel
Gunnison	Summit
Hinsdale	Teller
Huerfano	Washington
Jackson	Weld

STATE OF IDAHO

Bannock	Custer
Bear Lake	Franklin
Bingham	Fremont
Blaine	Jefferson
Bonneville	Madison
Butte	Minidoka
Camas	Oneida
Caribou	Power
Cassia	Teton
Clark	Valley

STATE OF MONTANA

Beaverhead	Madison
Deer Lodge	Meagher
Gallatin	Park
Jefferson	Silver Bow

STATE OF NEBRASKA

Banner	Sioux
Kimball	

STATE OF NEVADA

Carson City	Lander
Douglas	Lyon
Elko	Mineral
Esmeralda	Storey
Eureka	White Pine
Humboldt	

STATE OF NEW MEXICO

Bernalillo	Mora
Catron	Rio Arriba
Colfax	Sandoval
Curry	San Juan
De Baca	San Miguel
Grant	Santa Fe
Guadalupe	Sierra
Harding	Socorro
Lincoln	Taos
Los Alamos	Torrance
Luna	Union
McKinley	Valencia

STATE OF OREGON

Lake	

STATE OF UTAH

Beaver	Piute
Box Elder	Rich
Cache	Salt Lake
Carbon	San Juan
Daggett	Sanpete
Davis	Sevier
Duchesne	Summit
Emery	Tooele
Grand	Uintah
Iron	Utah
Juab	Wasatch
Kane	Wayne
Millard	Weber
Morgan	

STATE OF WYOMING

Albany	Natrona
Carbon	Niobrara
Converse	Park
Fremont	Platte
Goshen	Sublette
Hot Springs	Sweetwater
Johnson	Teton
Laramie	Uinta
Lincoln	Weston

(6) The provisions of paragraph (a)(4) of this section shall not apply to any light-duty vehicle or light-duty truck, sold, offered for sale, introduced, or delivered for introduction into commerce in California, provided that the vehicle is covered by a certificate of conformity with emission standards in effect in California.

(7) Certificates issued for light-duty vehicles or light-duty trucks certified with catalytic converters shall be subject to the following term in addition to the term in paragraph (a)(2) of this section: "Catalyst-equipped vehicles, otherwise covered by this certificate, which are driven outside the United States, Canada, and Mexico will be presumed to have been operated on leaded gasoline resulting in deactivation of the catalysts. If these vehicles are imported or offered for the importation without retrofit of the catalyst, they will be considered not to be within the coverage of this certificate unless included in a catalyst control program operated by a manufacturer or a United States Government Agency and approved by the Administrator."

(8) Certificates issued for incomplete light-duty trucks shall be subject to the following term in addition to the term in paragraph (a)(2) of this section: "For incomplete light-duty trucks, this certificate covers only those new motor vehicles which when completed by having the primary load-carrying device or container attached, conform to the maximum curb weight and frontal area limitations described in the application for certification as required in 40 CFR 86.079-21(d)."

(9) Certificates issued for heavy-duty engines shall be subject to the following term in addition to the term in paragraph (a)(2) of this section: "For heavy-duty engines, this certificate covers only those new motor vehicle engines installed in heavy-duty vehicles which conform to the minimum gross vehicle weight rating, curb weight, or frontal area limitations for heavy-duty vehicles described in 40 CFR 86.079-2."

(b)(1) The Administrator will determine whether a vehicle (or engine) covered by the application complies with applicable standards by observing the following relationships:

(i) *Light-duty vehicles and light-duty trucks.* (A) The durability-data vehicle(s) selected under § 86.079-24(c)(1)(i) shall represent all vehicles of the same engine-system combination.

(B) The emission-data vehicle(s) selected under § 86.079-24(b)(1)(ii), (b)(1)(iii), and (b)(1)(iv) shall represent all vehicles of the same engine-system combination as applicable to be sold below 4,000 ft.

(C) The emission-data vehicle(s) selected under § 86.079-24(b)(1)(vii)(A) and (b)(1)(vii)(B) shall represent all vehicles of the same evaporative control system within the evaporative family, as applicable, to be sold below 4,000 ft.

(D) The emission-data vehicle(s) selected under § 86.079-24(b)(1)(v) shall represent all vehicles of the same engine-system combination to be sold at high altitude.

(E) The emission-data vehicle(s) selected under § 86.079-24(b)(1)(vii)(D) shall represent all vehicles of the same evaporative control system within the evaporative family sold at high altitude.

(ii) *Gasoline-fueled heavy-duty engines.* (A) A test engine selected under § 86.079-24(b)(2)(ii) and (iv) shall represent all engines in the same engine family of the same engine displacement-exhaust emission control system combination.

(B) A test engine selected under § 86.079-24(b)(2)(iii) shall represent all engines in the same engine family of the same engine displacement-exhaust emission control system combination.

(C) A test engine selected under § 86.079-24(c)(2)(i) shall represent all engines of the same engine-system combination.

(iii) *Diesel heavy-duty engines.* (A) A test engine selected under § 86.079-24(b)(3)(ii) shall represent all engines in the same engine-system combination.

(B) A test engine selected under § 86.079-24(b)(3)(iii) shall represent all engines of that emission control system at the rated fuel delivery of the test engines.

(C) A test engine selected under § 86.078-24(c)(3)(i) shall represent all engines of the same engine-system combination.

(2) The administrator will proceed as in paragraph (a) of this section with respect to the vehicles (or engines) belonging to an engine family or engine family-evaporative emission family combination (as applicable), all of which comply with all applicable standards.

(3) If, after a review of the test reports and data submitted by the manufacturer, data derived from any additional testing conducted pursuant to § 86.079-29, data or information derived from any inspection carried out under § 86.078-7(c) or any other pertinent data or information, the Administrator determines that one or more test vehicles (or test engines) of the certification test fleet do not meet applicable standards, he will notify the manufacturer in writing, setting forth the basis for his determination. Within 30 days following receipt of the notification, the manufacturer may request a hearing on the Administrator's determination. The request shall be in writing, signed by an authorized representative of the manufacturer and shall include a statement specifying the manufacturer's objections to the Administrator's determination and data in support of such objections. If, after a review of the request and supporting data, the Administrator finds that the request raises a substantial factual issue, he shall provide the manufacturer a hearing in accordance with § 86.078-6 with respect to such issue.

(4) For light-duty vehicles and light-duty trucks the manufacturer may, at his option, proceed with any of the following alternatives with respect to an emission-data vehicle determined not in compliance with all applicable standards for which it was tested:

(i) Request a hearing under § 86.078-6; or

(ii) Remove the vehicle configuration (or evaporative vehicle configuration, as applicable) which failed, from his application;

(A) If the failed vehicle was tested for compliance with exhaust emission standards only: The Administrator may select, in place of the failed vehicle, in

accordance with the selection criteria employed in selecting the failed vehicle, a new emission-data vehicle to be tested for exhaust emission compliance only.

(B) If the failed vehicle was tested for compliance with both exhaust and evaporative emission standards: The Administrator may select, in place of the failed vehicle, in accordance with the selection criteria employed in selecting the failed vehicle, a new emission-data vehicle which will be tested for compliance with both exhaust and evaporative emission standards. If one vehicle cannot be selected in accordance with the selection criteria employed in selecting the failed vehicle, then two vehicles may be selected (i.e., one vehicle to satisfy the exhaust emission vehicle selection criteria and one vehicle to satisfy the evaporative emission vehicle selection criteria). The vehicle selected to satisfy the exhaust emission vehicle selection criteria will be tested for compliance with exhaust emission standards only. The vehicle selected to satisfy the evaporative emission vehicle selection criteria will be tested for compliance with both exhaust and evaporative emission standards; or

(iii) Remove the vehicle configuration (or evaporative vehicle configuration, as applicable) which failed from the application and add a vehicle configuration(s) (or evaporative vehicle configuration(s), as applicable) not previously listed. The Administrator may require, if applicable, that the failed vehicle be modified to the new engine code (or evaporative emission code, as applicable) and demonstrate by testing that it meets applicable standards for which it was originally tested. In addition, the Administrator may select, in accordance with the vehicle selection criteria given in § 86.079–24(b), a new emission-data vehicle or vehicles. The vehicles selected to satisfy the exhaust emission vehicle selection criteria will be tested for compliance with exhaust emission standards only. The vehicles selected to satisfy the evaporative emission vehicle selection criteria will be tested for compliance with both exhaust and evaporative mission standards; or

(iv) Correct a component or system malfunction and show that with a correctly functioning system or component the failed vehicle meets applicable standards for which it was originally tested. The Administrator may require a new emission-data vehicle, of identical vehicle configuration (or evaporative vehicle configuration, as applicable) to the failed vehicle, to be operated and tested for compliance with the applicable standards for which the failed vehicle was originally tested.

(5) For heavy-duty engines the manufacturer may, at his option, proceed with any of the following alternatives with respect to any engine family represented by a test engine(s) determined not in compliance with applicable standards:

(i) Request a hearing under § 86.-078–6; or

(ii) Delete from the application for certification the engines represented by the failing test engine. (Engines so deleted may be included in a later request for certification under § 86.079–32.) The Administrator will then select in place of each failing engine an alternate engine chosen in accordance with selection criteria employed in selecting the engine that failed; or

(iii) Modify the test engine and demonstrate by testing that it meets applicable standards. Another engine which is in all material respects the same as the first engine, as modified, shall then be operated and tested in accordance with applicable test procedures.

(6) If the manufacturer does not request a hearing or present the required data under paragraphs (b)(4) or (b)(5) (as applicable) of this section, the Administrator will deny certification.

(c) (1) Notwithstanding the fact that any certification vehicle(s) (or certification engine(s)) may comply with other provisions of this subpart, the Administrator may withhold or deny the issuance of a certificate of conformity (or suspend or revoke any such certificate which has been issued) with respect to any such vehicle(s) (or engine(s)) if:

(i) The manufacturer submits false or incomplete information in his application for certification thereof;

(ii) The manufacturer renders inaccurate or invalid any test data which he submits pertaining thereto or otherwise circumvents the intent of the Act or of this part with respect to such vehicle (or engine);

(iii) Any EPA Enforcement Officer is denied access on the terms specified in § 86.078–7(c) to any facility or portion thereof which contains any of the following:

(A) The vehicle (or engine);

(B) Any components used or considered for use in its modification or buildup into a certification vehicle (or certification engine);

(C) Any production vehicle (or production engine) which is or will be claimed by the manufacturer to be covered by the certificate;

(D) Any step in the construction of a vehicle (or engine) described in (C) of this subdivision;

(E) Any records, documents, reports, or histories required by this part to be kept concerning any of the above;

(iv) Any EPA Enforcement Officer is denied "reasonable assistance" (as defined in § 86.078–7(c)) in examining any of the items listed in paragraph (c)(1)(iii) of this section.

(2) The sanctions of withholding, denying, revoking, or suspending of a certificate may be imposed for the reasons in paragraphs (c)(1)(i), (ii), (iii), or (iv) of this section only when the infraction is substantial.

(3) In any case in which a manufacturer knowingly submits false or inaccurate information or knowingly renders inaccurate or invalid any test data or commits any other fraudulent acts and such acts contribute substantially to the Administrator's decision to issue a certificate of conformity, the Administrator may deem such certificate void ab initio.

(4) In any case in which certification of a vehicle (or engine) is proposed to be withheld, denied, revoked, or suspended under paragraph (c)(1)(iii) or (c)(1)(iv) of this section, and in which the Administrator has presented to the manufacturer involved reasonable evidence that a violation of § 86.078–7(c) in fact occurred, the manufacturer, if he wishes to contend that, even though the violation occurred, the vehicle (or engine) in question was not involved in the violation to a degree that would warrant withholding denial, revocation, or suspension of certification under either paragraph (c)(1)(iii) or (c)(1)(iv) of this section, shall have the burden of establishing that contention to the satisfaction of the Administrator.

(5) Any revocation or suspension of certification under paragraph (c)(1) of this section shall:

(i) Be made only after the manufacturer concerned has been offered an opportunity for a hearing conducted in accordance with § 86.078–6 hereof.

(ii) Extend no further than to forbid the introduction into commerce of vehicles (or engines) previously covered by the certification which are still in the hands of the manufacturer, except in cases of such fraud or other misconduct as makes the certification invalid ab initio.

(6) The manufacturer may request in the form and manner specified in paragraph (b)(3) of this section that any determination made by the Administrator under paragraph (c)(1) of this section to withhold or deny certification be reviewed in a hearing conducted in accordance with § 86.078–6. If the Administrator finds, after a review of the request and supporting data, that the request raises a substantial factual issue he will grant the request with respect to such issue.

(d) (1) Notwithstanding the fact that any vehicle configuration or engine family may be covered by a valid outstanding certificate of conformity, the Administrator may suspend such outstanding certificate of conformity in whole or in part with respect to such vehicle configuration or engine family if:

(i) The manufacturer refuses to comply with the provisions of a test order issued by the Administrator pursuant to § 86.603; or

(ii) The manufacturer refuses to comply with any of the requirements of § 86.603; or

(iii) The manufacturer submits false or incomplete information in any report or information provided pursuant to the requirements of § 86.609; or

(iv) The manufacturer renders inaccurate any test data which he submits pursuant to § 86.609; or

(v) Any EPA Enforcement Officer is denied access to a facility on the terms specified in § 86.606; or

(vi) Any EPA Enforcement Officer is denied the opportunity on the terms specified in § 86.606 to:

(A) Monitor vehicle selection pursuant to § 86.607, or

(B) Select vehicles for testing pursuant to § 86.607, or

(C) Monitor vehicle testing performed to satisfy any of the requirements of this part; or

(vii) Any EPA Enforcement Officer is denied "reasonable assistance" as defined in § 86.606 in examining any of the items listed in that section; or

(viii) The manufacturer refuses to comply with the requirements of §§ 86.604(a), 86.605, and 86,607, 86.608, 86.610, or 86.611.

(2) The sanction of suspending a certificate may not be imposed for the reasons in paragraphs (d)(1) (i), (ii), or (viii) of this section where such refusal is caused by conditions and circumstances outside the control of the manufacturer which renders it impossible to comply with those requirements. Such conditions and circumstances shall include, but not be limited to, any uncontrollable factors which result in the temporary unavailability of equipment and personnel needed to conduct the required tests, such as equipment breakdown or failure or illness of personnel, but shall not include failure of the manufacturer to adequately plan for and provide the equipment and personnel needed to conduct the tests. The manufacturer will bear the burden of establishing the presence of the conditions and circumstances required by this paragraph.

(3) The sanctions of suspending a certificate may be imposed for the reasons in paragraphs (d)(1)(iii), (iv), (v), (vi), or (vii) of this section only when the infraction is substantial.

(4) In any case in which a manufacturer knowingly submitted false or inaccurate information or knowingly rendered inaccurate any test data or committed any other fraudulent acts, and such acts contributed substantially to the Administrator's original decision not to suspend or revoke a certificate of conformity in whole or in part, the Administrator may deem such certificate void from the date of such fraudulent act.

(5) In any case in which certification of a vehicle is proposed to be suspended under paragraph (d)(1)(v), (d)(1)(vi), or (d)(1)(vii) of this section, and in which the Administrator has presented to the manufacturer involved reasonable evidence that a violation of § 86.606 in fact occurred, the manufacturer, if he wishes to contend that even though the violation occurred, the vehicle configuration or engine family in question was not involved in the violation to the degree that would warrant suspension of certification under either paragraph (d)(1)(v), (d)(1)(vi), or (d)(1)(vii) of this section, shall have the burden of establishing that contention to the satisfaction of the Administrator.

(6) Any suspension of certification under paragraph (d)(1) of this section shall:

(i) Be made only after the manufacturer concerned has been offered an opportunity for a hearing conducted in accordance with § 86.613 hereof, and

(ii) Not apply to vehicles no longer in the hands of the manufacturer.

11. New §§ 86.079–31 through 86.079–34 are added and read as follows:

§ 86.079–31 Separate certification.

Where possible a manufacturer should include in a single application for certification all vehicles (or engines) for which certification is required. A manufacturer may, however, choose to apply separately for certification of part of his product line. The selection of test vehicles (or test engines) and the computation of test results will be determined separately for each application.

§ 86.078–32 Addition of a vehicle or engine after certification.

(a) If a manufacturer proposes to add to his product line a vehicle (or engine) of the same engine-system combination as vehicles (or engines) previously certified but which was not described in the application for certification when the test vehicle(s) (or test engine(s)) representing other vehicles (or engines) of that combination was certified, he shall notify the Administrator. Such notification shall be in advance of the addition unless the manufacturer elects to follow the procedure described in § 86.079–34. This notification shall include a full description of the vehicle (or engine) to be added.

(b) The Administrator may require the manufacturer to perform such tests on the test vehicle(s) (or test engine(s)) representing the vehicle (or engine) to be added which would have been required if the vehicle (or engine) had been included in the original application for certification.

(c) If, after a review of the test reports and data submitted by the manufacturer, and data derived from any testing conducted under § 86.079–29, the Administrator determines that the test vehicle(s) or test engine(s) meets all applicable standards, the appropriate certificate will be amended accordingly. If the Administrator determines that the test vehicle(s) (or test engine(s)) does not meet applicable standards, he will proceed under § 86.079–30(b).

§ 86.079–33 Changes to a vehicle or engine covered by certification.

(a) The manufacturer shall notify the Administrator of any change in production vehicles (or production engines) in respect to any of the parameters listed in § 86.079–24(a)(3), § 86.079–24(b)(1)(iii), § 86.079–24(b)(2)(iii) or § 86.079–24(b)(3)(iii) as applicable, giving a full description of the change. Such notification shall be in advance of the change unless the manufacturer elects to follow the procedure described in § 86.079–34.

(b) Based upon the description of the change, and data derived from such testing as the Administrator may require or conduct, the Administrator will determine whether the vehicle (or engine), as modified, would still be covered by the certificate of conformity then in effect.

• (c) If the Administrator determines that the outstanding certificate would cover the modified vehicles (or engines) he will notify the manufacturer in writing. Except as provided in § 86.079–34 the change may not be put into effect prior to the manufacturer's receiving this notification. If the Administrator determines that the modified vehicles (or engines) would not be covered by the certificate then in effect, the modified vehicles (or engines) shall be treated as additions to the product line subject to § 86.079–32.

§ 86.079–34 Alternative procedure for notification of additions and changes.

(a) A manufacturer may, in lieu of notifying the Administrator in advance of an addition of a vehicle (or engine) under § 86.079–32 or a change in a vehicle (or engine) under § 86.079–33 notify him concurrently with the making of the change if the manufacturer believes the addition or change will not require any testing under the appropriate section. Upon notification to the Administrator, the manufacturer may proceed to put the addition or change into effect.

(b) The manufacturer may continue to produce vehicles (or engines) as described in the notification to the Administrator for a maximum of 30 days, unless the Administrator grants an extension in writing. This period may be shortened by a notification in accordance with paragraph (c) of this section.

(c) If the Administrator determines, based upon a description of the addition or change, that no test data will be required, he will notify the manufacturer in writing of the acceptability of the addition or change. If the Administrator determines that test data will be required, he will notify the manufacturer to rescind the change within 5 days of receipt of the notification. The Administrator will then proceed as in § 86.079–32 (b) and (c), or § 86.079–33 (b) and (c), as appropriate.

(d) Election to produce vehicles (or engines) under this section will be deemed to be a consent to recall all vehicles (or engines) which the Administrator determines under § 86.079–32(c) do not meet applicable standards, and to cause such nonconformity to be remedied at no expense to the owner.

12. Section 86.079–35 is revised to read as follows:

§ 86.079–35 Labeling.

(a) The manufacturer of any motor vehicle (or motor vehicle engine) subject to the applicable emission standards of this subpart, shall, at the time of manufacture, affix a permanent legible label, of the type and in the manner described below, containing the information hereinafter provided, to all production models of such vehicles (or engines) available for sale to the public and covered by a certificate of conformity under § 86.079–30(a).

(1) *Light-duty vehicles and light-duty trucks.* (i) A permanent, legible label shall be affixed in a readily visible position in the engine compartment.

(ii) The label shall be affixed by the vehicle manufacturer who has been issued the certificate of conformity for such vehicle, in such a manner that it cannot be removed without destroying or defacing the label. The label shall not

be affixed to any equipment which is easily detached from such vehicle.

(iii) The label shall contain the following information lettered in the English language in block letters and numerals, which shall be of a color that contrasts with the background of the label:

(A) The label heading: Vehicle Emission Control Information;

(B) Full corporate name and trademark of manufacturer;

(C) Engine displacement (in cubic inches), engine, family identification and evaporative family identification;

(D) Engine tuneup specifications and adjustments, as recommended by the manufacturer in accordance with the altitude at which the vehicle is to be sold to the ultimate purchaser, including but not limited to idle speed(s), ignition timing, the idle air-fuel mixture setting procedure and value (e.g., idle CO, idle air-fuel ratio, idle speed drop), high idle speed, initial injection timing, and valve lash (as applicable) as well as other parameters deemed necessary by the manufacturer. These specifications should indicate the proper transmission position during tuneup and what accessories (e.g., air-conditioner), if any, should be in operation;

(E) An unconditional statement of compliance with the appropriate model year U.S. Environmental Protection Agency regulations which apply to light-duty vehicles or light-duty trucks;

(F) The altitude at which the vehicle is intended for sale to the public as specified by a certificate of conformity under § 86.079–30.

(2) *Heavy-duty engines.* (i) A permanent legible label shall be affixed to the engine in a position in which it will be readily visible after installation in the vehicle.

(ii) The label shall be attached to an engine part necessary for normal engine operation and not normally requiring replacement during engine life.

(iii) The label shall contain the following information lettered in the English language in block letters and numerals which shall be of a color that contrasts with the background of the label:

(A) The label heading: Engine Exhaust Emission Control Information;

(B) Full corporate name and trademark of manufacturer;

(C) Engine displacement (in cubic inches) and engine family and model designations;

(D) Date of engine manufacture (month and year);

(E) Engine specifications and adjustments as recommended by the manufacturer. These specifications should indicate the proper transmission position during tuneup and what accessories (e.g., air conditioner), if any, should be in operation;

(F) For gasoline-fueled engines the label should include the idle speed, ignition timing, and the idle air-fuel mixture setting procedure and value (e.g., idle CO, idle air-fuel ratio, idle speed drop), and valve lash.

(G) For Diesel engines the label should include the advertised hp. at rpm, fuel rate at advertised hp. in mm³/stroke, valve lash, initial injection timing, and idle speed.

(H) An unconditional statement of compliance with the appropriate model year (e.g., 1979) U.S. Environmental Protection Agency regulations applicable to heavy-duty engines.

(iv) The label may be made up of one or more pieces: *Provided*, That all pieces are permanently attached to the same engine or vehicle part as applicable.

(b) The provisions of this section shall not prevent a manufacturer from also reciting on the label that such vehicle (or engine) conforms to any applicable State emission standards for new motor vehicles (or new motor vehicle engines) or any other information that such manufacturer deems necessary for, or useful to, the proper operation and satisfactory maintenance of the vehicle (or engine).

(c)(1) The manufacturer of any light-duty vehicle or light-duty truck subject to the emission standards of this subpart, shall, in addition and subsequent to setting forth those statements on the label required by the Department of Transportation (DOT) pursuant to 49 CFR 567.4, set forth, on the DOT label or on an additional label located in proximity to the DOT label and affixed as described in 49 CFR 567.4(b), the following information in the English language, lettered in block letters and numerals not less than three thirty-seconds of an inch high, of a color that contrasts with the background of the label:

(i) The heading: "Vehicle Emission Control Information";

(ii) The statement: "This Vehicle Conforms to U.S. EPA Regulations Applicable to 1979 Model Year New Motor Vehicles".

(iii) One of the following statements, as applicable, in letters and numerals not less than six thirty-seconds of an inch high and of a color that contrasts with the background of the label:

(A) For all vehicles certified as non-catalyst-equipped: "NON-CATALYST";

(B) For all vehicles certified as catalyst-equipped which are included in a manufacturer's catalyst control program for which approval has been given by the Administrator: "CATALYST-APPROVED FOR IMPORT";

(C) For all vehicles certified as catalyst-equipped which are not included in a manufacturer's catalyst control program for which prior approval has been given by the Administrator: "CATALYST".

(2) In lieu of selecting either of the labeling options of paragraph (c)(1) of this section, the manufacturer may add the information required by paragraph (c)(1)(iii) of this section to the label required by paragraph (a) of this section. The required information will be set forth in the manner prescribed by paragraph (c)(1)(iii) of this section.

(d) Incomplete light-duty trucks or incomplete heavy-duty vehicles optionally certified as light-duty trucks shall have the following statement printed on the label required in paragraph (a)(1) of this section in lieu of the statement required by paragraph (a)(1)(iii)(E) of this section: "This vehicle conforms to U.S. EPA regulations applicable to 19— Model Year New Motor Vehicles when completed at a maximum curb weight of _____ pounds and a maximum frontal area of _____ square feet."

(e) Incomplete heavy-duty vehicles having an 8,500 pound gross vehicle weight rating or less shall have the following statement printed on the label required in paragraph (a)(2) or (a)(3) of this section in lieu of the statement required by paragraph (a)(2)(iii)(F) or (a)(3)(iii)(F) of this section: "This engine conforms to U.S. EPA regulations applicable to 19— Model Year New Heavy-Duty Engines when installed in a vehicle completed at a curb weight of more than 6,000 pounds or with a frontal area greater than 46 square feet."

(f) The manufacturer of any incomplete vehicle shall notify the purchaser of such vehicle of any curb weight, frontal area, or gross vehicle weight rating limitations affecting the emissions certificate applicable to that vehicle. This notification shall be transmitted in a manner consistent with National Highway Traffic Safety Administration safety notification requirements published in 40 CFR Part 568.

13. New §§ 86.079–36 through 86.079–39 are added and read as follows:

§ 86.079–36 Submission of vehicle identification numbers.

(a) The manufacturer of any light-duty vehicle or light-duty truck covered by a certificate of conformity under § 86.079–30(a) shall, not later than 60 days after its manufacture, submit to the Administrator the vehicle identification number of such vehicle: *Provided*, That this requirement shall not apply with respect to any vehicle manufactured within any State, as defined in section 302(d) of the Act.

(b) The requirements of this section may be waived with respect to any manufacturer who provides information satisfactory to the Administrator which will enable the Administrator to identify those vehicles which are covered by a certificate of conformity.

§ 86.079–37 Production vehicles and engines.

(a) Any manufacturer obtaining certification under this part shall supply to the Administrator, upon his request, a reasonable number of production vehicles (or engines) selected by the Administrator which are representative of the engines, emission control systems, fuel systems, and transmissions offered and typical of production models available for sale under the certificate. These vehicles (or engines) shall be supplied for testing at such time and place and for such reasonable periods as the Administrator may require. Heavy-duty engines supplied under this paragraph may be required to be mounted in chassis and

appropriately equipped for operation on a chassis dynamometer.

(b) (1) Any manufacturer of light-duty vehicles or light-duty trucks obtaining certification under this part shall notify the Administrator, on a quarterly basis, of the number of vehicles domestically produced for sale in the United States and the number of vehicles produced and imported for sale in the United States during the preceding quarter. A manufacturer may elect to provide this information every 60 days instead of quarterly, to combine it with the notification required under § 86.079–36. The notification must be submitted 30 days after the close of the reporting period. The vehicle production information required shall be submitted as follows:

(i) Total production volume expressed in terms of units produced;

(ii) Model type production volume, expressed for each model type in terms of units produced and as a percentage of total production;

(iii) Base level production volume, expressed for each base level in terms of units produced and as a percentage of:

(A) Total production of its respective model type(s), and

(B) Total production; and

(iv) Vehicle configuration production volume, expressed for each vehicle configuration in terms of units produced, and as a percentage of the total production of its respective base level. In addition, each vehicle configuration shall be identified by its appropriate engine-system combination.

(2) All light-duty vehicles and light-duty trucks covered by a certificate of conformity under § 86.079–30(a) shall be adjusted by the manufacturer to the ignition or injection timing specification detailed in § 86.079–36(a)(1)(iii)(D).

(c) Any heavy-duty engine manufacturer obtaining certification under this part shall notify the Administrator, on a quarterly basis, of the number of engines of such engine family-engine displacement-exhaust emission control system-fuel system combination produced for sale in the United States during the preceding quarter.

(d) The following definitions apply to this section:

(1) "Model type" means a unique combination of car line, basic engine, and transmission class.

(2) "Base level" means a unique combination of basic engine, inertia weight, and transmission class.

(3) "Vehicle configuration" means a unique combination of basic engine, engine code, inertia weight, transmission configuration, and axle ratio within a base level.

§ 86.079–38 Maintenance instructions.

(a) The manufacturer shall furnish or cause to be furnished to the purchaser of each new motor vehicle (or motor vehicle engine) subject to the standards prescribed in §§ 86.078–8, 86.079–9, 86.079–10, or 86.079–11, as applicable, written instructions for the maintenance and use of the vehicle (or engine) by the purchaser as may be reasonable and necessary to assure the proper functioning of emission control systems.

(1) Such instructions shall be provided for those vehicle and engine components listed in Appendix VI to this part (and for any other components) to the extent that maintenance of these components is necessary to assure the proper functioning of emission control systems.

(2) Such instructions shall be in clear, and to the extent practicable, nontechnical language.

(b) The maintenance instructions required by this section shall contain a general description of the documentation which the manufacturer will require from the ultimate purchaser or any subsequent purchaser as evidence of compliance with the instructions.

(c) *For gasoline-fuel light-duty vehicles and light-duty trucks.* (1) Such instructions shall specify the performance of all scheduled maintenance performed by the manufacturer under § 86.079–25(a)(2) or § 86.079–25(b)(2) as applicable, and shall explain the conditions under which EGR system and catalytic converter maintenance are to be performed (e.g., what type of warning device is being employed and whether the device is activated by component failure or the need for periodic maintenance).

(2) Such instructions shall indicate, for vehicles to be sold to ultimate purchasers at low altitude, what adjustments or modifications, if any, are necessary to allow the vehicle to meet emissions standards at high altitude. The maintenance instructions shall, if applicable, include a statement that the vehicle's emission control system was not designed for conversion to allow the vehicle to meet emissions standards when operated at high altitude.

(3) Such instructions shall indicate, for vehicles to be sold to ultimate purchasers at high altitude, what adjustments or modifications, if any, are necessary to allow the vehicle to meet emissions standards at low altitude. The maintenance instructions shall, if applicable, include a statement that the vehicle's emission control system was not designed for conversion to allow the vehicle to meet emissions standards when operated at low altitude.

(d) *For Diesel light-duty vehicles and light-duty trucks.* (1) Such instructions shall indicate, for vehicles to be sold to ultimate purchasers at low altitude, what adjustments or modifications, if any, are necessary to allow the vehicle to meet emissions standards at high altitude. The maintenance instructions shall, if applicable, include a statement that the vehicle's emission control system was not designed for conversion to allow the vehicle to meet emissions standards when operated at high altitude.

(2) Such instructions shall indicate, for vehicles to be sold to ultimate purchasers at high altitude, what adjustments or modifications, if any, are necessary to allow the vehicle to meet emissions standards at low altitude. The maintenance instructions shall, if applicable, include a statement that the vehicle's emission control system was not designed for conversion to allow the vehicle to meet emissions standards when operated at high altitude.

(e) For gasoline-fueled heavy-duty engines, such instructions shall specify the performance of all scheduled maintenance performed by the manufacturer under § 86.079–25(c)(2). Scheduled maintenance in addition to that performed on the durability-data engine under § 86.079–25(c)(2) may be recommended for reasons such as to offset the effects of operating conditions which differ from the dynamometer durability cycle or to increase the life of the engine beyond 1500 hours (or the equivalent). The instructions may schedule maintenance on a calendar time basis and/or mileage basis in addition to the engine service time basis that was followed by the manufacturer under § 86.079–25(c)(2).

(f) For Diesel heavy-duty engines, such instructions shall specify the performance of all scheduled maintenance performed by the manufacturer under § 86.079–25(c)(2). Scheduled maintenance in addition to that performed on the durability-data engine under § 86.079–25(c)(2) may be recommended for reasons such as to offset the effects of operating conditions which differ from the dynamometer durability cycle or to increase the life of the engine beyond 1,000 hours (or the equivalent). The instructions may schedule maintenance on a calendar time basis, mileage basis, engine service time basis, or combinations of each.

§ 86.079–39 Submission of maintenance instructions.

(a) The manufacturer shall provide to the Administrator, no later than the time of the submission required by § 86.079–23, a copy of the maintenance instructions which the manufacturer proposes to supply to the ultimate purchaser in accordance with § 86.079–38(a). The Administrator will review such instructions to determine whether they are reasonable and necessary to assure the proper functioning of the vehicle's (or engine's emission control systems. The Administrator will notify the manufacturer of his determination whether such instructions are reasonable and necessary to assure the proper functioning of the emission control systems.

(b) Any revision to the maintenance instructions which will affect emissions shall be supplied to the Administrator at least 30 days before being supplied to the ultimate purchaser unless the Administrator consents to a lesser period of time.

14. A new § 86.080–10 is added and reads as follows:

§ 86.080–10 Emission standards for 1980 gasoline-fueled heavy-duty engines.

(a)(1) Exhaust emissions from new 1980 model year gasoline-fueled heavy-duty engines shall not exceed one of the two following standards, to be selected at the manufacturer's option:

(i) (A) *Hydrocarbons.* 1.5 grams per brake horsepower hour.

(B) *Carbon monoxide.* 25 grams per brake horsepower hour.

(C) *Hydrocarbons plus oxides of nitrogen.* 10 grams per brake horsepower hour.

(ii) (A) *Hydrocarbons plus oxides of nitrogen.* 5.0 grams per brake horsepower hour.

(B) *Carbon monoxide.* 25 grams per brake horsepower hour.

(2) The standards set forth in paragraph (a) (1) of this section refer to exhaust gaseous emissions generated under the conditions set forth in Subpart D of this part and measured in accordance with those procedures. For low-volume manufacturers, as defined in § 86.080–24(e), the test procedure in either Subpart D or Subpart H of this part may be used; however, standards (a) (1) (i) (A) and (a) (1) (i) (C) shall be reduced by 0.5 gram per brake horsepower hour if Subpart H of this part is used.

(b) [Reserved]

(c) No crankcase emissions shall be discharged into the ambient atmosphere from any new 1980 and later model year gasoline-fueled heavy-duty engine.

(d) Every manufacturer of new motor vehicle engines subject to the standards prescribed in this section shall, prior to taking any of the actions specified in section 203(a) (1) of the Act, test or cause to be tested motor vehicle engines in accordance with applicable procedures to ascertain that such test engines meet the requirements of paragraphs (a) and (c) of this section.

15. A new § 86.080–11 is added and reads as follows:

§ 86.080–11 Emissions standards for 1980 Diesel heavy-duty engines.

(a) (1) Exhaust emissions from new 1980 model year Diesel heavy-duty engines shall not exceed one of the two following standards, to be selected at the manufacturer's option:

(i) (A) *Hydrocarbons.* 1.5 grams per brake horsepower hour.

(B) *Carbon monoxide.* 25 grams per brake horsepower hour.

(C) *Hydrocarbon plus oxides of nitrogen.* 10 grams per brake horsepower hour.

(ii) (A) *Hydrocarbons plus oxides of nitrogen.* 5 grams per brake horsepower hour.

(B) *Carbon monoxide.* 25 grams per brake horsepower hour.

(2) The standards set forth in paragraph (a) (1) of this section refer to exhaust gaseous emissions generated under the conditions set forth in Subpart D of this part and measured in accordance with those procedures. For low volume manufacturers, as defined in § 86.080–24 (e), the test procedure in either Subpart D or Subpart J of this part may be used.

(b) (1) The opacity of smoke emissions from new 1980 and later model year Diesel heavy-duty engines shall not exceed:

(i) 20 percent during the engine acceleration mode.

(ii) 15 percent during the engine lugging mode.

(iii) 50 percent during the peaks in either mode.

(2) The standards set forth in paragraph (b) (1) of this section refer to exhaust smoke emissions generated under the conditions set forth in Subpart I and measured and calculated in accordance with those procedures.

(c) [Reserved]

(d) Every manufacturer of new motor vehicle engines subject to the standards prescribed in this section shall, prior to taking any of the actions specified in section 203(a) (1) of the Act, test or cause to be tested motor vehicle engines in accordance with applicable procedures to ascertain that such test engines meet the requirements of paragraphs (a) and (b) of this section.

15. A new § 86.080–24 is added and reads as follows:

§ 86.080–24 Test vehicles and engines.

(a) (1) The vehicles or engines covered by an application for certification will be divided into groupings of engines which are expected to have similar emission characteristics throughout their useful life. Each group of engines with similar emission characteristics shall be defined as a separate engine family.

(2) To be classed in the same engine family, engines must be identical in all the following respects:

(i) The cylinder bore center-to-center dimensions.

(ii) The dimension from the centerline of the crankshaft to the centerline of the camshaft.

(iii) The dimension from the centerline of the crankshaft to the top of the cylinder block head face.

(iv) The cylinder block configuration (air cooled or water cooled; L–6, 90° V–8, etc.).

(v) The location of intake and exhaust valves (or ports) and the valve (or port) sizes (within a ⅛-inch range on the valve head diameter).

(vi) The method of air aspiration.

(vii) The combustion cycle.

(viii) Catalytic converter characteristics.

(ix) Thermal reactor characteristics.

(x) Type of air inlet cooler (e.g., inter-coolers and after-coolers) for Diesel heavy-duty engines.

(3) Engines identical in all the respects listed in paragraph (a) (2) of this section may be further divided into different engine families if the Administrator determines that they may be expected to have different emission characteristics. This determination will be based upon a consideration of the following features of each engine.

(i) The bore and stroke.

(ii) The surface-to-volume ratio of the nominally dimensioned cylinder at the top dead center position.

(iii) The intake manifold induction port size and configuration.

(iv) The exhaust manifold port size and configuration.

(v) The intake and exhaust valve sizes.

(vi) The fuel system.

(vii) The camshaft timing and ignition or injection timing characteristics.

(4) Where engines are of a type which cannot be divided into engine families based upon the criteria listed in paragraphs (a) (2) and (3) of this section, the Administrator will establish families for those engines based upon the features most related to their emission characteristics.

(5) The gasoline-fueled vehicles covered by an application for certification will be divided into groupings which are expected to have similar evaporative emission characteristics throughout their useful life. Each group of vehicles with similar evaporative emission characteristics shall be defined as a separate evaporative emission family.

(6) To be classed in the same evaporative emission family, vehicles must be identical in all of the following respects:

(i) Type of vapor storage device (e.g., canister, air cleaner, crankcase).

(ii) Basic canister design.

(iii) Fuel system.

(7) Where vehicles are of a type which cannot be divided into evaporative emission families based on the criteria listed above, the Administrator will establish families for those vehicles based upon the features most related to their evaporative emission characteristics.

(b) Emission data:

(1) *Emission-data vehicles.* Paragraph (b) (1) of this section applies to light-duty vehicle and light-duty truck emission-data vehicles.

(i) Vehicles will be chosen to be operated and tested for emission data based upon the engine family groupings. Within each engine family, the requirements of this paragraph must be met.

(ii) Vehicles of each engine family will be divided into engine displacement-exhaust emission control system combinations as applicable. A projected sales volume will be established for each combination for the model year for which certification is sought. One vehicle of each combination will be selected in order of decreasing projected sales volume until 70 percent of the projected sales of the manufacturer's total production of vehicles of that engine family is represented, or until a maximum of four vehicles is selected. If any single combination represents over 70 percent, then two vehicles of that combination may be selected. The vehicle selected for each combination will be specified by the Administrator as to such features as engine code, transmission type, fuel system, and inertia weight class.

(iii) The Administrator may select a maximum of four additional vehicles within each engine family based upon features indicating that they may have the highest emission levels of vehicles in that engine family. In selecting these vehicles, the Administration will consider such features as the emission control system combination, induction system characteristics, ignition system characteristics, fuel system, rated horsepower, rated torque, compression ratio,

inertia weight class, transmission options, and axle ratios.

(iv) If the vehicles selected in accordance with paragraphs (b)(1)(ii) and (iii) of this section do not represent each engine-system combination, then one vehicle of each engine-system combination not represented will be selected by the Administrator. The vehicle selected shall be of the engine displacement with the largest projected sales volume of vehicles with the control system combination in the engine family and will be designated by the Administrator as to such features as transmission type, fuel system, and inertia weight class.

(v) The Administrator will also select one vehicle for each engine-system combination within an engine family for which vehicles are to be sold to ultimate purchasers at high altitude.

(vi) The Administrator may combine testing requirements for any vehicle selected under paragraph (b)(1)(v) or (b)(1)(vii)(D) of this section with the testing requirements for any similar vehicle in the same engine-system combination selected under paragraph (b)(1)(ii), (iii), or (iv) of this section or any similar vehicle in the same engine-system, evaporative emission family, evaporative emission control system combination selected under paragraph (b)(1)(vii)(A) or (B) of this section. The testing requirements may be combined by the Administrator requiring a vehicle selected for testing under paragraphs (b)(1)(ii), (iii), (iv), (vii)(A), or (vii)(B) of this section to be modified (if necessary) after mileage accumulation and emission testing for the purpose of demonstrating compliance with § 86.080–23(b)(1)(ii).

(vii) (A) Vehicles of each evaporative emission family will be divided into evaporative emission control systems. One vehicle of each evaporative emission control system within the evaporative emission family will be selected.

(B) The Administrator may select a maximum of four (4) additional vehicles within each evaporative emission family based upon features indicating that they may have the highest evaporative emission levels of vehicles in that family.

(C) The Administrator may determine that the vehicles selected under paragraph (b)(1)(ii) through (iv) of this section may be used to satisfy the requirements of paragraph (b)(1)(vii)(A) and (B) of this section.

(D) The Administrator will also select one vehicle for each evaporative emission control system within each evaporative family for which vehicles are to be sold at high altitude.

(E) Vehicles selected under paragraph (b)(1)(v) of this section may be used to satisfy the requirements of paragraph (b)(1)(vii)(D) of this section.

(2) *Gasoline-fueled heavy-duty emission-data engines.* Paragraph (b)(2) of this section applies to gasoline-fueled heavy-duty emission-data engines.

(i) Engines will be chosen to be run for emission data based upon the engine family groupings. Within each engine family, the requirements of this paragraph must be met.

(ii) Engines of each engine family will be divided into engine displacement-exhaust emission control system combinations. A projected sales volume will be established for each combination for the applicable model year. One engine of each combination will be selected in order of decreasing projected sales volume until 70 percent of the projected sales of a manufacturer's total production of engines of that family is represented, or until a maximum of four engines is selected. The engines selected for each combination will be specified by the Administrator as to fuel system.

(iii) The Administrator may select a maximum of two additional engines within each engine family based upon features indicating that they may have the highest emission levels of the engines in that engine family. In selecting these engines, the Administrator will consider such features as the exhaust emission control system, induction system characteristics, ignition system characteristics, fuel system, rated horsepower, rated torque, and compression ratio.

(iv) If the engines selected in accordance with pargaraphs (b)(2)(ii) and (iii) of this section do not represent each engine displacement-exhaust emission control system combination, then one engine of each engine displacement-exhaust emission control system combination not represented shall be selected by the Administrator.

(3) *Diesel heavy-duty emission-data engines.* Paragraph (b)(3) of this section applies to Diesel heavy-duty emission-data engines.

(i) Engines will be chosen to be run for emission data based upon engine family groupings. Within each engine family, the requirements of this paragraph must be met.

(ii) Engines of each engine family will be divided into groups based upon their exhaust emission control systems. One engine of each engine-system combination shall be run for smoke emission data and gaseous emission data as prescribed in § 86.079–26(c)(3). Either the complete gaseous emission test or the complete smoke test may be conducted first. Within each combination, the engine that features the highest fuel feed per stroke, primarily at the speed of maximum rated torque and secondarily at rated speed, will usually be selected. If there are military engines with higher fuel rates than other engines in the same engine system combinations, then one military engine shall be also selected. The engine with the highest fuel feed per stroke will usually be selected.

(iii) The Administrator may select a maximum of one additional engine within each engine-system combination based upon features indicating that it may have the highest emission levels of the engines of that combination. In selecting this engine, the Administrator will consider such features as the injection system, fuel system, compression ratio, rated speed, rated horsepower, peak torque speed, and peak torque.

(c) Durability data: (1) *Durability-data vehicles.* Paragraph (c)(1) of this section applies to light-duty vehicle and light-duty truck durability-data vehicles.

(i) A durability-data vehicle will be selected by the Administrator to represent each engine-system combination. The vehicle selected shall be of the engine displacement with the largest projected sales volume of vehicles with that control-system combination in that engine family and will be designated by the Administrator as to transmission type, fuel system, and inertia weight class.

(ii) A manufacturer may elect to operate and test additional vehicles to represent any engine-system combination. The additional vehicles must be of the same engine displacement, transmission type, fuel system, and inertia weight class as the vehicle selected for that engine-system combination in accordance with the provisions of paragraph (c)(1)(i) of this section. Notice of an intent to operate and test additional vehicles shall be given to the Administrator not later than 30 days following notification of the test fleet selection.

(2) *Gasoline-fueled heavy-duty durability-data engines.* Paragraph (c)(2) of this section applies to gasoline-fueled heavy-duty durability-data engines.

(i) A durability-data engine will be selected by the Administrator to represent each engine-system combination. The engine selected shall be of the displacement with the largest projected sales volume of engines with that exhaust emission control system in that engine family and will be designated by the Administrator as to fuel system.

(ii) [Reserved]

(iii) A manufacturer may elect to operate and test additional engines to represent any engine-system combination. The additional engines must be of the same engine displacement and fuel system as the engine selected for that combination in accordance with the provisions of paragraph (c)(2)(i) of this section. Notice of an intent to run additional engines shall be given to the Administrator not later than 30 days following notification of the test fleet selection. Deterioration factors calculated for each engine-system combination shall be applied separately to military and nonmilitary engines within the same engine-system combination.

(3) *Diesel heavy-duty durability-data engines.* Paragraph (c)(3) of this section applies to Diesel heavy-duty durability-data engines.

(i) One engine from each engine-system combination shall be tested as prescribed in § 86.079–26(c)(3)(ii). At each test point, either the complete gaseous emission test or the complete smoke test may be conducted first. Within each combination, the engine which features the highest fuel feed per stroke, primarily at rated speed and secondarily at the speed of maximum rated torque, will usually be selected for durability testing. In the case where more than one engine in an engine-system combination has the highest fuel feed per stroke, the engine with the highest maximum rated horsepower will usually be selected for durability testing. If an engine-system combination

includes both military and nonmilitary engines, then the nonmilitary engine with the highest maximum rated horsepower will usually be selected for durability testing.

(ii) A manufacturer may elect to operate and test additional engines to represent any engine-system combination. The additional engines must be of the same model and fuel system as the engine selected in accordance with the provisions of paragraph (c)(3)(i) of this section. Notice of an intent to test additional engines shall be given to the Administrator not later than 30 days following notification of the test fleet selection. Deterioration factors calculated for each engine-system combination shall be applied separately to military and nonmilitary engines within the same engine system combination.

(d) For purposes of testing under § 86.079–26 (a)(9), (b)(9), or (c)(11), the Administrator may require additional emission-data vehicles (or emission-data engines) and durability-data vehicles (or durability-data engines) identical in all material respects to vehicles (or engines) selected in accordance with paragraphs (b) and (c) of this section: *Provided*, That the number of vehicles (or engines) selected shall not increase the size of either the emission-data fleet or the durability-data fleet by more than 20 percent or one vehicle (or engine), whichever is greater.

(e) Any manufacturer whose projected sales for the model year in which certification is sought is less than

(1) 2,000 gasoline-fueled light-duty vehicles, or (2) 2,000 Diesel light-duty vehicles, or (3) 2,000 gasoline-fueled light-duty trucks, or (4) 2,000 Diesel light-duty trucks, or (5) 2,000 gasoline-fueled heavy-duty engines, or (6) 2,000 Diesel heavy-duty engines,

may request a reduction in the number of test vehicles (or engines) determined in accordance with the foregoing provisions of this section. The Administrator may agree to such lesser number as he determines would meet the objectives of this procedure.

(f) (1) In lieu of testing an emission-data or durability-data vehicle (or engine) selected under paragraph (b) or (c) of this section, and submitting data therefore, a manufacturer may, with the prior written approval of the Administrator, submit exhaust emission data and/or fuel evaporative emission data, as applicable on a similar vehicle (or engine) for which certification has previously been obtained or for which all applicable data required under § 86.079–23 has previously been submitted.

(2) Heavy-duty engine test data submitted prior to the 1980 model year and which complies with paragraph (f)(1) of this section, can be used in subsequent model years, without regard to the test procedure. Any heavy-duty engine certified in the 1979 model year will be certified for 1980 and subsequent model years if requested by the manufacturers.

(g) (1) This paragraph applies to light-duty vehicles and light-duty trucks.

(2) Where it is expected that more than 33 percent of an engine family will be equipped with an optional item, the full estimated weight of that item shall be included, unless excluded by the Administrator, in the curb weight computation for each vehicle available with that option in the engine family. Where it is expected that 33 percent or less of the vehicles in an engine family will be equipped with an item of optional equipment, no weight for that item will be added in computing curb weight. In the case of mutually exclusive options, only the weight of the heavier option will be added in computing curb weight. Optional equipment weighing less than 3 pounds per item need not be considered.

(3) Where it is expected that more than 33 percent of an engine family will be equipped with an item of optional equipment that can reasonably be expected to influence emissions, then such items of optional equipment shall actually be installed, unless specifically excluded by the Administrator, on all emission-data and durability-data vehicles in the engine family on which the option is intended to be offered in production. Optional equipment that can reasonably be expected to influence emissions are the air conditioner, power steering, power brakes, and other items determined by the Administrator.

(4) Optional equipment that can reasonably be expected to influence emissions and which is utilized on 33 percent or less of the vehicles in the engine family shall not be installed on any vehicle in that engine family unless specifically required under this section.

16. A new Subpart D is added to Part 86 and reads as follows:

Subpart D—Emission Regulations for New Gasoline-Fueled and Diesel Heavy-Duty Engines; Gaseous Exhaust Test Procedures

Sec.

86.301–79 Scope; applicability.
86.302–79 Definitions.
86.303–79 Abbreviations.
86.304–79 Section numbering; construction.
86.305–79 Introduction; structure of subpart.
86.306–79 Equipment required and specifications; overview.
86.307–79 Fuel specifications.
86.308–79 Gas specifications.
86.309–79 Sampling and analytical system; schematic drawing.
86.310–79 Sampling and analytical system; component specifications.
86.311–79 Miscellaneous equipment; specifications.
86.312–79 Dynamometer and engine equipment specifications.
86.313–79 Air flow measurement specifications; Diesel engines.
86.314–79 Fuel flow measurement specifications.
86.315–79 General analyzer specifications.
86.316–79 Carbon monoxide and carbon dioxide analyzer specifications.
86.317–79 Hydrocarbon analyzer specifications.
86.318–79 Oxides of nitrogen analyzer specifications.
86.319–79 Analyzer checks and calibrations; frequency and overview.
86.320–79 Analyzer bench check.
86.321–79 NDIR water rejection ratio check.
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86.323 through 86.326 [Reserved]
86.327–79 Quench check; NOx analyzer.
86.328–79 Leak checks.
86.329–79 System response-time; check procedure.
86.330–79 NDIR analyzer calibration.
86.331–79 Hydrocarbon analyzer calibration.
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§ 86.333–79 Dynamometer calibration.
§ 86.334–79 Test procedure overview.
§ 86.335–79 Gasoline-fueled engine test cycle.
§ 86.336–79 Diesel engine test cycle.
§ 86.337–79 Information.
§ 86.338–79 Exhaust measurement accuracy.
§ 86.339–79 Pre-test procedures.
§ 86.340–79 Gasoline-fueled engine dynamometer test run.
§ 86.341–79 Diesel engine dynamometer test run.
§ 86.342–79 Post-test procedure.
§ 86.343–79 Chart reading.
§ 86.344–79 Humidity calculations.
§ 86.345–79 Emission calculations.
§ 86.346–79 Alternative NOx measurement technique.
§ 86.347–79 Alternative calculations for Diesel engines.

AUTHORITY: Secs. 202, 206, 207, 208, 301(a), Clean Air Act, as amended (42 U.S.C. 1857f–1, 1857f–5, 1857f–5a, 1857f–6, 1857g(a))

Subpart D—Emission Regulations for New Gasoline-Fueled and Diesel Heavy-Duty Engines; Gaseous Exhaust Test Procedures.

§ 86.301–79 Scope; applicability.

This subpart contains gaseous emission test procedures for gasoline-fueled and Diesel heavy-duty engines. It applies to 1979 and later model years.

§ 86.302–79 Definitions.

The definitions in § 86.077–2, § 86.078–2, and § 86.079–2 apply to this subpart.

§ 86.303–79 Abbreviations.

The abbreviations in § 86.078–3 apply to this subpart.

§ 86.304–79 Section numbering; construction.

(a) The model year of initial applicability is indicated by the section number. The two digits following the hyphen designate the first model year for which a section is effective. A section remains effective until superseded.

Example: Section § 86.311–79 applies to the 1979 and subsequent model years until superseded. If a section § 86.311–81 is promulgated it would take effect beginning with the 1981 model year; § 86.311–79 would apply to model years 1979 and 1980.

(b) A section reference without a model year suffix refers to the section applicable for the appropriate model year.

(c) Unless indicated, all provisions in this subpart apply to both gasoline-fueled and Diesel heavy-duty engines.

§ 86.305–79 Introduction; structure of subpart.

(a) This subpart describes the equipment required and the procedures to follow in order to perform exhaust emission tests on gasoline-fueled and Diesel heavy-duty engines. Subpart A sets forth the testing requirements and test intervals necessary to comply with EPA certification procedures.

(b) Four topics are addressed in this subpart. Sections 86.306 through 86.318 set forth specifications and equipment requirements; §§ 86.319 through 86.333 discuss calibration methods and frequency; test procedures and data requirements are listed (in approximately chronological order) in §§ 86.334 through 86.343; and calculation formulas are found in §§ 86.344 and 86.345. Alternative procedures and calculations are set forth in §§ 86.346 and 86.347.

§ 86.306–79 Equipment required and specifications; overview.

(a) This subpart contains procedures for both gasoline-fueled and Diesel engine gaseous emission tests. Generally, the equipment required is identical for both types of engines. Equipment required and specifications are found in §§ 86.307 through 86.318.

(b) Some analyzer specifications refer to calibration checks found in §§ 86.320 through 86.332.

§ 86.307–79 Fuel specifications.

(a) *Gasoline.* (1) Gasoline having the following specifications will be used by the Administrator in exhaust emission testing. Gasoline having the following specifications or substantially equivalent specifications approved by the Administrator shall be used by the manufacturer in exhaust testing, except that the lead and octane specifications do not apply.

Item designation	ASTM	Leaded	Unleaded
Octane, research, minimum	D2699	100	98.
Pb. (organic), grams/U.S. gallon		1.4 [1]	0.00 to 0.05.
Distillation range:			
IBP, °F	D86	75 to 95	75 to 95.
10 pct point, °F	D86	120 to 135	120 to 135.
50 pct point, °F	D86	200 to 230	200 to 230.
90 pct point, °F	D86	300 to 325	300 to 325.
EP, °F (maximum)	D86	415	415.
Sulfur, weight percent, maximum	D1266	0.10	0.10.
Phosphorus, grams/U.S. gallon, maximum		0.01	0.005.
RVP, pounds	D323	8.0 to 9.2	8.0 to 9.2.
Hydrocarbon composition—Olefins, percent, maximum	D1319	10	10.
Aromatics, percent, maximum	D1319	35	35.
Saturates	D1319	Remainder	Remainder.

[1] Minimum.

(2) Gasoline representative of commercial gasoline which will be generally available through retail outlets shall be used in service accumulation. For leaded gasoline, the minimum lead content shall be 1.4 grams per U.S. gallon, except that where the Administrator determines that engines represented by a test engine will be operated using gasoline of different lead content from that prescribed in this paragraph, he may consent in writing to use of a gasoline with a different lead content. The octane rating of the gasoline used shall be no higher than 4.0 research octane numbers above the minimum recommended by the manufacturer and have a minimum sensitivity of 8.0 octane numbers for unleaded fuel and 7.0 octane numbers for leaded fuel, where sensitivity is defined as research octane number minus motor octane number.

(b) *Diesel fuel.* (1) The Diesel fuels employed for testing shall be clean and bright, with pour and cloud points adequate for operability. The Diesel fuel may contain nonmetallic additives as follows: Cetane improver, metal deactivator, antioxidant, dehazer, antirust, pour depressant, dye, and dispersant.

(2) Diesel fuel meeting the following specifications, or substantially equivalent specifications approved by the Administrator, shall be used in exhaust emissions testing. The grade of Diesel fuel recommended by the engine manufacturer commercially designated as "Type 1–D" or "Type 2–D", shall be used.

Item	ASTM test Method No.	Type 1–D	Type 2–D
Cetane	D613	48 to 54	42 to 50.
Distillation range	D86		
IBP, °F		330 to 390	340 to 400.
10 pct point, °F		370 to 430	400 to 460.
50 pct point, °F		410 to 480	470 to 540.
90 pct point, °F		460 to 520	550 to 610.
EP, °F		500 to 560	590 to 660.
Gravity, °API	D287	40 to 44	33 to 37.
Total sulfur, percent	D129 or D2622	0.05 to 0.50	0.2 to 0.5.
Hydrocarbon composition	D1319		
Aromatics, percent		8 (minimum)	27 (minimum).
Paraffins, naphthenes, olefins		Remainder	Remainder.
Flash point, °F. (minimum)	D93	130	130.
Viscosity, centistokes	D445	1.6 to 2.0	2.0 to 3.2.

(3) Diesel fuel meeting the following specifications, or substantially equivalent specifications approved by the Administrator, shall be used in service accumulation. The grade of Diesel fuel recommended by the engine manufacturer, commercially designated as "Type 1–D" or "Type 2–D", shall be used.

ASTM test method number

Item	ASTM test method No.	Type 1–D	Type 2–D
Cetane (minimum)	D613	42 to 56	38 to 58.
Distillation range 90 pct point, °F	D86	440 to 530	540 to 630.
Gravity, °API	D287	39 to 45	30 to 42.
Total sulfur, percent	D129 or D2622	0.05 (minimum)	0.2 (minimum).
Flash point, °F (minimum)	D96	130	130.
Viscosity, centistokes	D445	1.2 to 2.2	1.5 to 4.5.

(4) Other petroleum distillate fuels may be used for testing and service accumulation provided:

(i) They are commercially available;

(ii) Information, acceptable to the Administrator, is provided to show that only the designated fuel would be used in customer service;

(iii) Use of a fuel listed under paragraphs (b)(2) and (b)(3) of this section would have a detrimental effect on emissions or durability; and,

(iv) Written approval from the Administrator of the fuel specifications was provided prior to the start of testing.

(5) The specification range of the fuels to be used under subparagraphs (b)(2), (b)(3), and (b)(4) of this section shall be reported in accordance with § 86.079–21(b)(3).

§ 86.308–79 Gas specifications.

(a) *Analyzer gases.* (1) Calibration or span gases for the CO and CO_2 analyzers shall have zero-grade nitrogen as a diluent.

(2) Calibration or span gases for the hydrocarbon analyzer shall be propane with zero-grade nitrogen as a diluent when testing gasoline-fueled engines. For Diesel engine tests the diluent shall be zero-grade air.

(3) Calibration or span gases for the NO_x analyzer shall be NO named as NO_x with a maximum NO_2 concentration of 5 percent of the nominal value. Zero-grade nitrogen shall be the diluent.

(4) Zero-grade gases for hydrocarbon analyzers shall be nitrogen when testing gasoline-fueled engines and air when testing Diesel engines.

(5) Zero-grade gases for the carbon monoxide, carbon dioxide and oxides of nitrogen analyzers shall be either zero-grade air or zero-grade nitrogen.

(6) The allowable zero grade gas (air or nitrogen) impurity concentrations shall not exceed 2 ppmC hydrocarbon, 10 ppm carbon monoxide, 400 ppm carbon dioxide and 1 ppm nitric oxide.

(7) "Zero-grade air" includes artificial "air" consisting of a blend of nitrogen and oxygen with oxygen concentrations between 18 and 21 mole percent.

(b) *Calibration gas.* Calibration gas values are to be derived from NBS "Standard Reference Materials" (SRM's) or other gas standards approved by the Administrator. The uncertainty of the assigned calibration gas values shall not exceed 2.0 percent of the assigned value. The uncertainly is defined as the sum of the precision errors (at the 90 percent confidence level) and the bias errors. Precision and bias errors apply to both the equipment and the derivation procedures.

(c) *Span gas.* Span gas values are to be derived from NBS "Standard Reference Materials" (SRM's) or other gas standards approved by the Administrator. The uncertainty of the assigned calibration gas values shall not exceed 3.0 percent of the assigned value. The uncertainty is defined as the sum of the precision errors (at the 90 percent confidence level) and the bias errors. Precision and bias errors apply to both the equipment and the derivation procedures.

(d) *Hydrocarbon analyzer fuel*—(1) *The fuel shall contain 40±2 percent hydrogen.* The balance shall be helium. The mixture shall contain less than 2 ppmC hydrocarbon.

(2) *Alternate pure hydrogen fuel.* Some HFID's are designed to operate on pure hydrogen. Generally the HFID fuel is incompatible with good relative hydrocarbon response.

(i) For Diesel engines this fuel is not recommended. However, this fuel may be used if the engine manufacturer demonstrates, on each basic combustion system (i.e., 4 cycle DI, 2 cycle DI, 4 cycle pre-cup, etc.) that an HFID using this fuel produces comparable results to an HFID using 40% H_2/60% He fuel. These data must be submitted to and approved by the Administrator prior to testing. Pure H_2 fuel, that may be allowed for testing, must contain at least 99.0 percent hydrogen and contain less than 2 ppmC hydrocarbon.

(ii) For gasoline-fueled engines, pure hydrogen fuel for the HFID is not allowed.

(e) *Hydrocarbon analyzer burner air.* The concentration of oxygen must be within 1 mole percent of the oxygen concentration of the burner air used in the latest oxygen interference check ($\%O_2I$). If the difference in oxygen concentration is greater than 1 mole percent, then the oxygen interference must be checked and the analyzer adjusted, if necessary, to meet the $\%O_2I$ requirements. The burner air must contain less than 2 ppmC hydrocarbon.

(f) Oxygen interference check gases shall contain propane with 350 ppmC ±75 ppmC hydrocarbon. The concentration value shall be determined to calibration gas tolerances by chromatographic analysis of total hydrocarbons plus impurities or by dynamic blending. Nitrogen shall be the predominant diluent with the balance oxygen. Blends required for gasoline-fueled and Diesel engine testing are as follows:

Applicability	O_2 concentration (percent)	Balance
Diesel	21 (20 to 22)	N_2
Diesel and gasoline	10 (9 to 11)	N_2
Do	5 (4 to 6)	N_2
Gasoline	0 (0 to 1)	N_2

§ 86.309–79 Sampling and analytical system; schematic drawing.

(a) Any variation from the specifications in this subpart including performance specifications and emission detection methods may be used only with prior approval by the Administrator.

(b) Schematic drawing.

(1) An example of a sampling and analytical system which may be used for testing under this subpart is shown in Figure D79–1. All components or parts of components that are wetted by the sample or corrosive calibration gases shall be either chemically cleaned stainless steel or inert material, e.g. polytetrafluoroethylene resin. The use of "gauge savers" or "protectors" with nonreactive diaphragms to reduce dead volumes is permitted. The specific detection methods to be used for each exhaust component can be found in § 86.316 for CO, § 86.317 for HC, and § 86.318 for NO_x. Additional components such as instruments, valves, solenoids, pumps, switches, etc. may be employed to provide additional information and coordinate the functions of the component systems.

(2) The following requirements must be incorporated in each system used for testing under this subpart.

(i) All analyzers must obtain the sample to be analyzed from the same sample line.

(ii) The sample transport system from the engine exhaust pipe to the HC analyzer and the NO_x analyzer must be heated as is indicated in Figure D79–1.

(iii) Carbon monoxide and carbon dioxide measurements must be made on a dry basis. Specific requirements for the means of drying the sample can be found in § 86.309(b)(5) and § 86.311(e).

(iv) All NDIR analyzers must have a pressure gauge immediately downstream of the analyzer. The gauge tap must be within 2 inches of the analyzer exit port. Gauge specifications can be found in § 86.309(b)(3).

(v) All bypass and analyzer flows exiting the analysis system must be measured. Capillary flows such as in HFID and CL analyzers are excluded. For each NDIR analyzer with a flow meter located upstream of the analyzer, an upstream pressure gauge must be used. The gauge tap must be within 2 inches of the analyzer entrance port.

(vi) Calibration or span gases for the NO_x measurement system must pass through the NO_2 to NO converter.

(vii) The temperature of the NO_2 to NO converter must be displayed continuously.

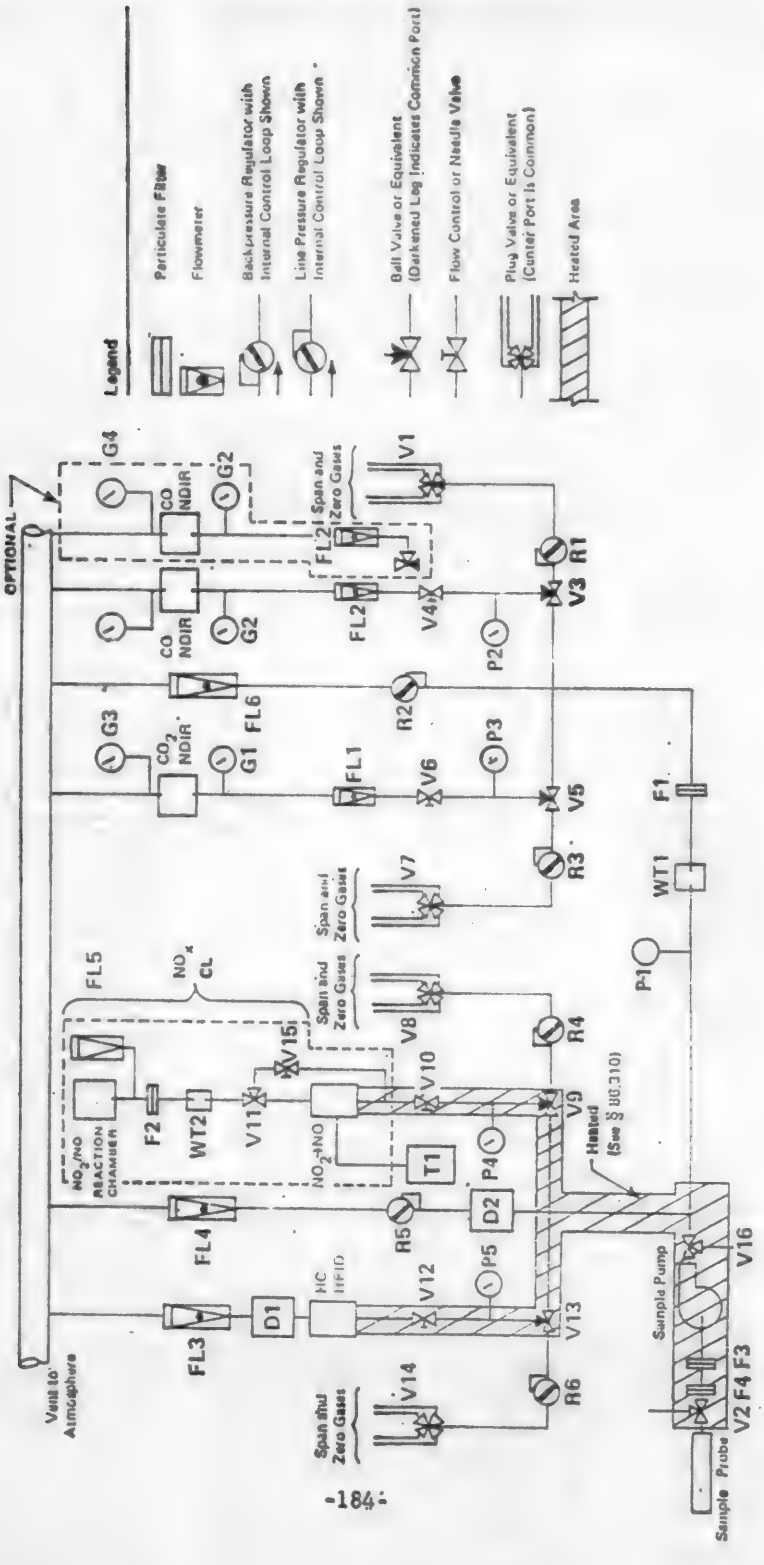

Figure D79-1 HEAVY-DUTY EXHAUST GAS SAMPLING AND ANALYTICAL TRAIN

(c) *System components list.* The following is a list of components shown in Fig. D79–1 by numeric identifier.

(1) *Filters.* Glass fiber filter paper is permitted for F1, F2, and F3. Optional filter F4 is a coarse filter for large particulates.

(i) F1—Fine particulate filter.

(ii) F2—Fine particulate filter.

(iii) F3—Fine heated particulate filter.

(iv) F4—Coarse heated particulate filter.

(2) *Flowmeters.* (i) Flowmeters FL 1 and FL 2 indicate sample flow rates through the CO and CO_2 analyzers.

(ii) Flowmeters FL 3, FL 4, FL 5, and FL 6 indicate bypass flow rates.

(3) *Gauges.* Downstream gauges are required for any system used for testing under this subpart. Upstream gauges may be required under this subpart per § 86.309(b)(2)(v).

(i) Upstream gauges G1 and G2 measure the input pressure to the CO and CO_2 analyzers.

(ii) Downstream gauges G3 and G4 measure the exit pressure of the CO and CO_2 analyzers. If the normal operating range of the downstream gauges is less than 3 inches of water, then the downstream gauge must be capable of reading both pressure and vacuum.

(4) *Pressure gauges.* (i) P1—bypass pressure.

(ii) P2, P3, P4 and P5—sample or span pressure at inlet to flow control valves.

(5) *Water traps.* Water traps WT1, and WT2 to remove water from the sample. A water trap performing the function of WT1 and meeting the specifications in § 86.311(e) is required for any system used for testing under this subpart. Chemical dryers are not an acceptable method of removing the water. Water removal by condensation is acceptable. Means other than condensation may be used only with prior approval from the Administrator.

(6) *Regulators.* (i) R1, R3, R4, and R6—line pressure regulators to control span pressure at inlet to flow control valves.

(ii) R2 and R5—back pressure regulators to control sample pressure at inlet to flow control valves.

(7) *Valves.* (i) V1, V7, V8, and V14—selector valves to select zero or calibration gases.

(ii) V2—optional heated selector valve to purge the sample probe, perform leak checks, or to perform hang-up checks.

(iii) V3 and V5—Selector valves to select sample or span gases.

(iv) V4, V6, and V15—flow control valves.

(v) V9 and V13—heated selector valve to select sample or span gases.

(vi) V10 and V12—heated flow control valves.

(vii) VII—Selector valve to select NO_x or bypass mode in the chemiluminescence analyzer.

(viii) V16—heated selector valve to perform leak checks.

(8) *Pump.* Sample transfer pump to transport sample to analyzers.

(9) *Temperature sensor.* A temperature sensor (T1) to measure the NO_2 to NO converter temperature is required for any system used for testing under this subpart.

(10) *Dryer.* Dryers D1 and D2 to remove the water from the bypass flows to prevent condensation in flowmeters FL3, FL4, and FL6.

§ 86.310–79 Sampling and analytical system; component specifications.

(a) *Temperature.* (1) For gasoline-fueled engines any heated component;

(i) in the HC sample path must be maintained above 110°C (230°F) and shall not exceed 230°C (446°F),

(ii) in the NO_x sample path must be maintained above 95°C (203°F) and shall not exceed 230°C (446°F).

(2) For Diesel engines any heated component;

(i) in the HC sample path must be maintained above 180°C (356°F) and shall not exceed 230°C (446°F),

(ii) in the NO_x sample path must be maintained above 95°C (203°F) and shall not exceed 230°C (446°F).

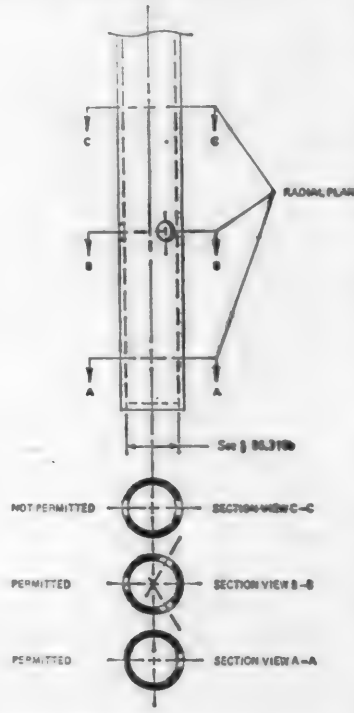

Figure D79-2 SAMPLE PROBE AND TYPICAL HOLE SPACINGS

(3) The sample line outside wall temperature must be maintained at the temperature specified in this paragraph. An exception is made for the first 4 feet of sample line from the exhaust duct. The upper temperature tolerance for this 4 foot section is waived and only the minimum temperature specification applies.

(b) *Sample probe.* (1) The sample probe shall be a straight, closed end, stainless steel, multi-hole probe. The Inside Diameter (I.D.) shall not be greater than the I.D. of the sample line (+.010 in.). The wall thickness of the probe shall not be greater than .040 inch. The fitting that attaches the probe to the exhaust pipe shall be as small as practical in order to minimize heat loss from the probe.

(2) There shall be a minimum of three holes in the probe. The spacing of the radial planes for each hole in the probe must be such that they cover approximately equal cross-sectional areas of the exhaust duct. The angular spacing of the holes must be approximately equal. The angular spacing of any two holes in one plane may not be 180°±20° (i.e., section C–C of Figure D79–2). The holes should be sized such that each has approximately the same flow. If only three holes are used, they may not all be in the same radial plane. See Figure D79–2.

(3) The probe shall extend radially across the exhaust duct. The probe must pass through the approximate center and must extend across at least 80 percent of the diameter of the duct.

(c) *Sample transfer.* (1) The maximum I.D. of the sample line shall not exceed 0.52 inch.

(2) If valve V2 is used, the sample probe must connect directly to valve V2. The location of optional valve V2 may not be greater than 4 feet from the exhaust duct.

(3) The location of optional valve V16 may not be greater than 24 inches from the sample pump. The leakage rate for this section on the pressure side of the sample pump may not exceed the leakage rate specification for the vacuum side of the pump.

(d) *Venting.* All vents including analyzer vents, bypass flows, and pressure relief vents of regulators should be vented in such a manner to avoid endangering personnel in the immediate area.

§ 86.311–79 Miscellaneous equipment; specifications.

(a) *Chart recorders.* (1) The minimum chart speed allowed is 3 inches per minute for gasoline-fueled engines and 0.5 inches per minute for Diesel engines.

(2) When testing gasoline-fueled engines all chart recorders (analyzers, torque, rpm, etc.) shall be provided with Automatic markers which indicate one second intervals. Preprinted chart paper (one second intervals) may be used in lieu of the automatic markers provided the correct chart speed is used.

(b) *Accuracy of temperature measurements.* (1) The following temperature measurements shall be accurate to within 1.2° C:

(i) temperature measurements used in calculating the engine intake humidity;

(ii) the temperature of the fuel in volume measuring flow rate devices;

(iii) The temperature of the sample within the water trap(s).

(2) All other temperature measurements shall be accurate within 2.5° C.

(c) *Intake air humidity and temperature measurements.* (1) Humidity conditioned air supply. Air that has had its absolute humidity altered is considered humidity-conditioned air. For this type of intake air supply, the humidity measurement must be made within the intake

air supply system, and after the humidity conditioning has taken place.

(2) Nonconditioned air supply. Humidity measurements in non-conditioned intake air supply systems must be made in the intake air stream entering the supply system. Alternatively, the humidity measurements can be measured within the intake air supply stream.

(3) Engine intake air temperature measurement must be made within 48 inches of the engine. The measurement location must be made either in the supply system or in the air stream entering the supply system.

(d) *Sample component surface temperature.* For each component (pump, sample line section, filters, etc.) in the heated portion of the sampling system that has a separate source of power or heating element, use engineering judgment to locate the coolest portion of that component and monitor the temperature at that location. If several components are within an oven, then only the surface temperature of the component with the largest thermal mass and the oven temperature need be measured.

(e) If water is removed by condensation the sample gas temperature within the water trap must be monitored and may not exceed 7° C (45° F).

§ 86.312–79 Dynamometer and engine equipment specifications.

(a) *Dynamometer.* (1) The dynamometer test stand and other instruments for measurement of power output shall be accurate to within 2 percent of point at all power settings above 10 percent of full-scale. Below 10 percent of full-scale the accuracy shall be within 5 percent of point. The dynamometer must be capable of performing the test cycle described in § 86.335 or § 86.336. Dynamometers used for testing gasoline-fueled engines must have sufficient motoring capability to meet the test requirements. A 60-tooth wheel in combination with a frequency counter shall be considered an absolute standard for engine speed.

(2) *Dynamometer calibration weights.* A minimum of 6 calibration weights for each range used are required. The weights must be equally spaced and traceable to within 0.5 percent of NBS weights. Laboratories located in foreign countries may certify calibration weights to local government bureau standards.

(b) *Engine cooling.* Means of engine cooling which will maintain the engine operating temperatures (e.g., intake air, oil, water, etc.) at approximately the same temperature as specified by the manufacturer shall be used. Auxiliary fan(s) may be used to maintain engine cooling during operation on the dynamometer.

(c) *Exhaust system.* (1) When testing gasoline-fueled engines:

(i) A chassis-type single exhaust pipe shall be used. Standard or specially fabricated "Y" pipes may be used on engines designed for dual exhaust systems.

(ii) For all catalyst systems, the distance from the exhaust manifold flange(s) to the catalyst shall be the same as in the vehicle configuration unless the manufacturer provides temperature data showing equivalent performance at another location.

(iii) For catalyst systems, the probe shall be located in the single exhaust pipe and from 2 to 10 feet downstream of the catalyst(s).

(iv) For noncatalyst systems, the probe shall be located in the single exhaust pipe and from 3 to 20 feet downstream from the exhaust manifold flange or turbocharger exit flange.

(v) For all exhaust systems, the probe shall be located at least 24 inches from the end of the tail pipe. Additional exhaust pipe may be added to the tail pipe to meet the specification.

(2) When testing Diesel engines, a noninsulated exhaust system extending 15±5 feet from the exhaust manifold, or the crossover junction in the case of Vee engines, shall be used. The exhaust back pressure must be within 0.2 inch Hg. of the upper limit at maximum rated horsepower, as established by the engine manufacturer in his sales and service literature for vehicle application. A conventional automotive muffler of a size and type commonly used with the engine being tested shall be employed in the exhaust system during smoke emission testing. The terminal 2 feet of the exhaust pipe shall be a circular cross section and be free of elbows and bends. The end of the pipe shall be cut off squarely. The terminal 2 feet of the exhaust pipe shall have a nominal inside diameter in accordance with the engine being tested, as specified below:

Maximum rated horsepower:	*Exhaust pipe inside diameter (inches)*
Less than 101	2
101 to 200	3
201 to 300	4
301 or more	5

§ 86.313–79 Air flow measurement specifications; Diesel engines.

(a) The air flow measurement method used must have a range large enough to accurately measure the air flow over the engine operating range during the test. Overall measurement accuracy must be ±2 percent of full-scale value of the measurement device for all modes except the idle and 2-percent modes. For the idle and 2-percent modes, the measurement accuracy shall be ±5 percent or less of the full-scale value. The Administrator must be advised of the method used prior to testing.

(b) Corrections to the measured air mass-flow-rate shall be made when an engine system incorporates devices that add or subtract air mass (air injection, bleed air, etc.). The method used to determine the air mass from these devices shall be approved by the Administrator.

(c) An engine air inlet system presenting an air inlet restriction within 1 inch of water of the upper limit for the engine operating condition which results in maximum air flow, as established by the engine manufacturer in his sales and service literature, for the Diesel engine being tested shall be used.

§ 86.314–79 Fuel flow measurement specifications.

(a) The fuel flow rate measurement instrument must have a minimum accuracy of ±1 percent of full-scale flow rate for each measurement range used. An exception for Diesel engines is allowed at the idle and 2-percent power points. For these modes, the minimum accuracy is ±2 percent of full-scale flow rate for each measurement range used. The controlling parameters are the elapsed time measurement of the event and the weight or volume measurement. Restrictions on these parameters are:

(1) The error in the elapsed time measurement of the event must not be greater than 1 percent of the absolute event time. This includes errors in starting and stopping the clock as well as the period of the clock.

(2) For Diesel engines only, if the mass of fuel consumed is measured by discrete weights, then the error in the actual weight of the fuel consumed must not be greater than ±1 percent of the measuring weight. An exception for Diesel engines is allowed at the idle and 2-percent power points. For these modes the error in the actual weight of the fuel consumed must not be greater than ±2 percent of the measuring weight.

(3) If the mass of fuel consumed is measured electronically (load cell, load beam, etc.), the error in the actual weight of fuel consumed must not be greater than ±1 percent of the full-scale value of the electronic device.

(4) If the mass of fuel consumed is measured by volume flow and density, the error in the actual volume consumed must not be greater than ±1 percent of the full-scale value of the volume measuring device.

(b) For devices that have varying mass scales (electronic weight, volume, density, etc.), measurements may not be used for calculations if the measurement is less than 20 percent of full scale.

(c) *Option.* Complete flow-rate measurement systems may be used below 20 percent of full-scale measurement as long as the combination of mass and time measurements indicate a flow rate that has an error of less than 5 percent of the absolute flow rate.

§ 86.315–79 General analyzer specifications.

(a) *Analyzer response time.* The analyzer must respond to an instantaneous step change at the entrance to the analyzer with a response equal to 95 percent of that step change in 6.0 seconds or less on all ranges used. The step change shall be at least 60 percent of full-scale chart deflection. For NO_x analyzers using a water trap, the response time increase due to the water trap and associated plumbing need not be included in the analyzer response time.

(b) *Precision.* The precision of the analyzer must be no greater than ±1 percent of full-scale concentration for each range used. The precision is defined as 2.5 times the standard deviation(s) of 10 repetitive responses to a given calibration or span gas.

(c) *Noise.* The analyzer peak-to-peak response to zero and calibration or span gases over any 10-second period shall not exceed 2 percent of full-scale chart deflection on all ranges used.

(d) *Zero drift.* The analyzer zero-response drift during a 1-hour period shall be less than 2 percent of full-scale chart deflection on the lowest range used. The zero-response is defined as the mean response including noise to a zero-gas during a 30-second time interval.

(e) *Span drift.* The analyzer span drift during a 1-hour period shall be less than 2 percent of full-scale chart deflection on the lowest range used. The analyzer span is defined as the difference between the span-response and the zero-response. The span-response is defined as the mean response including noise to a span gas during a 30-second time interval.

§ 86.316–79 Carbon monoxide and carbon dioxide analyzer specifications.

(a) Carbon monoxide and carbon dioxide measurements are to be made with nondispersive infrared (NDIR) analyzers.

(b) The use of linearizing circuits is permitted.

(c) The minimum water rejection ratio (maximum CO_2 interference) as measured by § 86.321 shall be:

(i) For CO analyzers, 1000:1.

(ii) For CO_2 analyzers, 100:1.

(d) The minimum CO_2 rejection ratio (maximum CO_2 interference) as measured by § 86.322 for CO analyzers shall be 5000:1.

(e) *Zero suppression.* Various techniques of zero suppression may be used to increase readability, but only with prior approval by the Administrator.

§ 86.317–79 Hydrocarbon analyzer specifications.

(a) Hydrocarbon measurements are to be made with a heated flame ionization detector (HFID) analyzer.

(b) *Option.* A non-heated flame ionization detector (FID) that measures hydrocarbon emissions on a dry basis is permitted for gasoline-fueled testing; *Provided,* That equivalency is demonstrated to the Administrator. With the exception of temperatures, all specifications contained in Subpart D apply to the optional system.

(c) The analyzer shall be fitted with a constant temperature oven housing the detector and sample-handling components. It shall maintain temperature within 2° C of the set point. The detector, oven, and sample-handling components within the oven shall be suitable for continuous operation at temperatures to 200° C.

(d) Fuel and burner air shall conform to the specifications in § 86.308.

(e) The percent of oxygen interference must be less than 3 percent, as specified in § 86.331(d)(7).

(f) Premixed burner air:

(1) For Diesel engines, premixing a small amount of air with the HFID fuel prior to combustion within the HFID burner is not recommended as a means of improving oxygen interference ($\%O_2I$). However, this procedure may be used if the engine manufacturer demonstrates on each basic combustion system (i.e., 4 cycle DI, 2 cycle DI, 4 cycle precup, etc.) that an HFID using this procedure produces comparable results to an HFID not using this procedure. These data must be submitted to the Administrator for his approval prior to testing.

(2) For gasoline-fueled engines, premixing burner air with the HFID fuel is not allowed.

§ 86.318–79 Oxides of nitrogen analyzer specifications.

(a) Oxides of nitrogen are to be measured with a chemiluminescence analyzer.

(1) The NO_x sample must be heated per § 86.309(a) and § 86.310(a) up to the NO_2 to NO converter.

(2) For high vacuum CL analyzers with heated capillary modules, supplying a heated sample to the capillary module is sufficient.

(3) The NO_2 to NO convertor efficiency shall be at least 90 percent.

(4) The quench interference must be less than 3.0 percent as measured in § 86.327.

(b) *Option.* The oxides of nitrogen may be measured with an NDIR analyzer system that meets the following specifications:

(1) The system shall include an NO_2 to NO converter, a water trap, and an NDIR analyzer in that order.

(2) The NO_2 to NO converter shall obtain a sample directly from the heated sample line.

(3) The water trap shall meet the specifications in § 86.311(e).

(4) The NO NDIR analyzer shall be calibrated per § 86.330.

(5) The minimum water rejection ratio (maximum water interference) for the NO NDIR analyzer shall be 5,000:1 (see § 86.321).

(6) The minimum CO_2 rejection ratio (maximum CO_2 interference) for the NO NDIR analyzer shall be 30,000:1 (see § 86.322).

§ 86.319–79 Analyzer checks and calibrations; frequency and overview.

(a) Prior to initial use and after major repairs bench check each analyzer (see § 86.320).

(b) At least once every 7 days during testing check the NO_x converter efficiency (see § 86.332).

(c) At least once every 30 days during testing perform the following:

(1) Leak check the pressure side of the system (see § 86.328). If the option described in § 86.328(b)(2) is used, a pressure leak check is not required.

(2) Calibate all analyzers (see §§ 86.330 through 86.332).

(3) Check the analysis system response time (see § 86.329). If the option described in § 86.329(b) is used, a response time check is not required.

(4) Verify that the automatic data collection system (if used) meets the chart reading requirements found in § 86.343.

(5) Check the fuel flow measurement instrument to insure that the specifications in § 86.314 are met. Flow meters of the tapered tube and float design (rotometers) or the balance beam principle need be checked only every 90 days.

(d) At least once every 90 days during testing check the water rejection ratio and the CO_2 rejection ratio on all NDIR analyzers (see §§ 86.321 and 86.322).

(e) At least once every 180 days during testing check the dynamometer test stand and power output instrumentation (see § 86.333).

§ 86.320–79 Analyzer bench check.

(a) Prior to initial use and after major repairs verify that each analyzer complies with the following specifications:

(1) Response time (see § 86.315(a)).

(2) Precision (see § 86.315(b)).

(3) Noise (see § 86.315(c)).

(4) Zero drift (see § 86.315(d)).

(5) Span drift (see § 86.315(e)).

(6) Water rejection ratio, NDIR analyzers only (see §§ 86.316(c) and 86.318(b)(5)).

(7) CO_2 rejection ratio, NDIR analyzers only (see §§ 86.316(d) and 86.318(b)(6)).

(8) Quench check, CL analyzers only (see § 86.327).

(b) If a stainless steel NO_2 to NO converter is used, condition all new or replacement converters. The conditioning consists of either purging the converter with air for a minimum of 4 hours or until the converter efficiency is greater than 90 percent. The converter must be at operational temperature while purging. Do not use this procedure prior to checking converter efficiency on in-use converters.

§ 86.321–79 NDIR water rejection ratio check.

(a) Zero and span the analyzer on the lowest range that will be used.

(b) Introduce a saturated mixture of water and zero gas at room temperature directly to the analyzer.

(c) Determine and record the analyzer operating pressure (GP) in absolute units in pascals. Gauges G3 and G4 may be used if the values are converted to the correct units.

(d) Determine and record the temperature of the zero-gas mixture.

(e) Record the analyzers' response (AR) in ppm to the saturated zero-gas mixture.

(f) For the temperature recorded in step (d), determine the saturation vapor pressure (P_{WB}) from § 86.344(d).

(g) Calculate the water concentration (Z) in the mixture from:

$$Z = (P_{WB}/GP)\,(10^6)$$

(h) Calculate the water rejection ratio (WRR) from:

$$WRR = (Z/AR)$$

§ 86.322–79 NDIR CO_2 rejection ratio check.

(a) Zero and span the analyzer on the lowest range that will be used.

(b) Introduce a CO_2 calibration gas of at least 10 percent CO_2 or greater to the analyzer.

(c) Record the CO_2 calibration gas concentration in *ppm*.

(d), Record the analyzers' response (*AR*) in *ppm* to the CO_2 calibration gas.

(e) Calculate the CO_2 rejection ratio (CO_2RR) from:

$$CO_2RR = (ppm\ CO_2)/AR.$$

§ 86.323 through § 86.326 [Reserved]

§ 86.327–79 Quench checks; NO_x analyzer.

(a) Perform the reaction chamber quench check for each model of high vacuum reaction chamber analyzer prior to initial use.

(b) Perform the reaction chamber quench check for each new analyzer that has an ambient pressure or "soft vacuum" reaction chamber prior to initial use. Additionally, perform this check prior to reusing an analyzer of this type any time any repairs could potentially alter any flow rate into the reaction chamber. This includes, but is not limited to, sample capillary, ozone capillary, and if used, dilution capillary.

(c) Quench check as follows:

(1) Calibrate the NO_x analyzer on the lowest range that will be used for testing.

(2) Introduce a mixture of CO_2 calibration gas and NO_x calibration gas to the CL analyzer. Dynamic blending may be used to provide this mixture. Dynamic blending may be accomplished by analyzing the CO_2 in the mixture. The change in the CO_2 value due to blending may then be used to determine the true concentration of the NO_x in the mixture. The CO_2 concentration of the mixture shall be approximately equal to the highest concentration experienced during testing. Record the response.

(3) Recheck the calibration. If it has changed more than ±1 percent of full scale, recalibrate and repeat the quench check.

(4) Prior to testing, the difference between the calculated NO_x response and the response of NO_x in the presence of CO_2 (step 2) must not be greater than 3.0 percent. The calculated NO_x response is based on the calibration performed in step (1).

§ 86.328–79 Leak checks.

(a) *Vacuum side leak check.* (1) Any location within the analysis system where a vacuum leak could affect the test results must be checked.

(2) The maximum allowable leakage rate on the vacuum side is 0.5 percent of the in-use flow rate for the portion of the system being checked. The analyzer flows and bypass flows may be used to estimate the in-use flow rates.

(3) The sample probe and the connection between the sample probe and valve V2 (Figure D79–1) may be excluded from the leak check.

(b) *Pressure side leak check.* (1) The maximum allowable leakage rate on the pressure side is 5 percent of the in-use flow rate.

(2) Option: If the flow rate for each flow meter is equal to or greater than the flow rate recorded in § 86.329(b)(1)(ii), then a pressure side leak check is not required.

§ 86.329–79 System response time; check procedure.

(a) Check the system response time by the following procedure:

(1) Stabilize the operating temperature of the sample line, sample pump, and heated filters.

(2) Introduce an HC span gas into the sampling system at the sample probe or valve V2 at atmospheric pressure. Simultaneously, start the time measurement.

(3) When the HC instrument response is 95 percent of the span gas concentration used, stop the time measurement.

(4) If the elapsed time is more than 20.0 seconds, make necessary adjustments.

(5) Repeat with the CO, CO_2, and NO_x instruments and span gases.

(b) Option. If the following parameters are determined, the initial system response time may be generally applied to future checks.

(1) Analyzer and bypass flow rates: (i) Determine by experimentation the minimum analyzer and bypass flow rates individually and in combination that will produce a response time as close as possible to 20.0 seconds per paragraph (a) of this section.

(ii) Record the highest minimum flow rate for each flow meter as determined in step (i).

(2) Capillary flow analyzers. This procedure is applicable only to analyzers that have sample capillaries such as the HFID and CL analyzers. It is also assumed that the system has sample/span valves that perform the function of valves V9 and V13 in Figure D79–1.

(i) Operate the analyzer(s) at the in-use capillary pressure.

(ii) Adjust the bypass flow rate to the flow rate recorded in paragraph (b)(1)(ii) of this section.

(iii) Measure and record the response time from the sample/span valve(s) per paragraph (a) of this section.

(iv) The response time (step (iii)) can be determined by switching from the "sample" position to the "span" position of the sample/span valve and observing the analyzer response on a chart recorder. Normally, the "sample" position would select a "room air" sample and the "span" position would select a span gas.

(v) Adjust the bypass flow rate to the normal in-use value.

(vi) Measure and record the response time from the sample/span valve(s) per paragraph (a) of this section.

(vii) Determine the slowest response time (step (iii) or step (iv)) and add 2 seconds to it.

§ 86.330–79 NDIR analyzer calibration.

(a) *Detector optimization.* If necessary, follow the manufacturer's instructions for initial start-up and basic operating adjustments.

(b) *Calibration curve.* Develop a calibration curve for each range used as follows:

(1) Zero the analyzer.

(2) Span the analyzer to give a response of approximately 90 percent of full-scale chart deflection.

(3) Recheck the zero response. If it has changed more than 0.5 percent of full scale, repeat steps (1) and (2).

(4) Record the response of calibration gases having nominal concentrations of 15, 30, 45, 60, 75, and 90 percent of full-scale concentration.

(5) Generate a calibration curve. The calibration curve shall be of fourth order or less, have five or fewer coefficients, and be of the form of equation (1) or (2). Include zero as a data point. Compensation for known impurities in the zero gas can be made to the zero-data point. The calibration curve must fit the data points within 2 percent of point or 1 percent of full scale, whichever is less.

$$y = Ax^4 + Bx^3 + Cx^2 + Dx + E \quad (1)$$

$$y = \frac{x}{Ax^4 + Bx^3 + Cx^2 + Dx + E} \quad (2)$$

where:
y = concentration
x = chart deflection

(6) *Option.* A new calibration curve need not be generated if: (i) A calibration curve conforming to step (5) exists; (ii) The responses generated in step (4) are within 1 percent of full scale or 2 percent of point, whichever is less, of the responses predicted by the calibration curve for the gases used in step (4).

(c) If any range is within 2 percent of being linear, a linear calibration may be used. To determine if this criterion is met:

(1) Perform a linear least-square regression on the data generated. Use an equation of the form $y = mx$, where x is the actual chart deflection and y is the concentration.

(2) Use the equation $z = y/m$ to find the linear chart deflection (z) for each calibration gas concentration (y).

(3) Determine the linearity (%L) for each calibration gas by:

$$\text{Percent } L = \frac{(z - x)}{\text{Full-scale linear chart deflection}} (100)$$

(4) The linearity criterion is met if the %L is less than ±2 percent for each data point generated. For each emission test, a calibration curve of the form $y = mx$ is to be used. The slope (m) is defined for each range by the spanning process.

§ 86.331–79 Hydrocarbon analyzer calibration.

The following steps are followed in sequence to calibrate the hydrocarbon analyzer. It is suggested, but not required, that efforts be made to minimize relative response variations.

(a) If necessary, follow manufacturer's instructions for instrument start-up and basic operating adjustments.

(b) Set the oven temperature 5°C hotter than the required sample-line temperature. Allow at least one-half hour after the oven has reached temperature for the system to equilibrate.

(c) Initial fuel flow adjustment. With the fuel and air-flow rates set at the

manufacturer's recommendations, introduce a 350 ppmC ± 75 ppmC span gas to the detector. Determine the response at a given fuel flow from the difference between the span-gas response and the zero-gas response. Incrementally adjust the fuel flow above and below the manufacturer's specification. Record the span and zero response at these fuel flows. A plot of the difference between the span and zero response versus fuel flow will be similar to the one shown in Fig. D79–3. Adjust the fuel-flow rate to the rich side of the curve, as shown. This is initial flow-rate setting and may not be the final optimized flow rate.

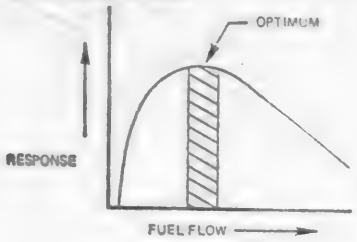

Figure D79-3 RESPONSE VS. FUEL FLOW

(d) Oxygen interference optimization. Choose a range where the oxygen interference check gases (see § 86.308) will fall in the upper 50 percent. Conduct this test with the oven temperature set as required. Oxygen interference check gas specifications are found in § 86.308.

(1) Zero the analyzer.

(2) Span the analyzer with the zero-percent oxygen blend for gasoline-fueled engines. Diesel engine instruments shall be spanned with the 21-percent oxygen blend.

(3) Recheck zero response. If it has changed more than 0.5 percent of full scale repeat subparagraphs (1) and (2) of this paragraph.

(4) Introduce the 5 percent and 10 percent oxygen interference check gases.

(5) Recheck the zero response. If it has changed more ±1 percent of full scale, repeat the test.

(6) Calculate the percent of oxygen interference (%O_2I) for each mixture in step (4).

$$\text{Percent } O_2I = \frac{B - \text{Analyser response } (ppmC)}{B} (100)$$

$$\text{Analyser response} = \frac{A}{\text{Percent of full-scale analyzer response due to } A} \times (\text{Percent of full-scale analyser response due to } B)$$

A=hydrocarbon concentration ($ppmC$) of the span gas used in step (2).

B=hydrocarbon concentration ($ppmC$) of the oxygen interference check gases used in step (4).

(7) The percent of oxygen interference (%O_2I) must be less than ±3.0 percent for all required oxygen interference check gases prior to testing.

(8) If the oxygen interference is greater than the specifications, incrementally adjust the air flow above and below the manufacturer's specifications, repeating subparagraphs (1) through (7) of this paragraph for each flow.

(9) If the oxygen interference is greater than the specification after adjusting the air flow, vary the fuel flow and thereafter the sample flow, repeating subparagraphs (1) through (7) of this paragraph for each new setting.

(10) If the oxygen interference is still greater than the specifications, repair or replace the analyzer, FID fuel, or burner air prior to testing. Repeat this section with the repaired or replaced equipment or gases.

(e) Linearity check. For each range used, check linearity as follows:

(1) With the fuel flow, air flow and sample flow adjust to meet the oxygen interference specification, zero the analyzer.

(2) Span the analyzer using a calibration gas that will provide a response of approximately 90 percent of full-scale concentration.

(3) Recheck the zero response. If it has changed more than 0.5 percent of full scale, repeat steps (1) and (2).

(4) Record the response of calibration gases having nominal concentrations of 30, 60, and 90 percent of full-scale concentration. It is permitted to use additional concentrations.

(5) Perform a linear least square regression on the data generated. Use an equation of the form $y=mx$, where x is the actual chart deflection and y is the concentration.

(6) Use the equation $z=y/m$ to find the linear chart deflection (z) for each calibration gas concentration (y).

(7) Determine the linearity (%L) for each calibration gas by:

$$\text{Percent } L = \frac{(z-x)}{\text{Full-scale linear chart deflection}} (100)$$

(8) The linearity criterion is met if the %L is less than ±2 percent for each data point generated. Below 40 $ppmC$ the linearity criterion may be expanded to ±4 percent. For each emission test, a calibration curve of the form $y=mx$ is to be used. The slope (m) is defined for each range by the spanning process.

(9) If the %L for any point exceeds the specifications in step (8), the air, fuel, and sample-flow rates may be varied within the boundaries of the oxygen interference specifications.

(10) If the %L for any data point still exceeds the specifications, repair or replace the analyzer, FID fuel, burner air, or calibration bottles prior to testing. Repeat the procedures of this section with the repaired or replaced equipment or gases.

(f) Optimized flow rates. The fuel-flow rate, air-flow rate and sample-flow rate are defined as "optimized" at this point.

§ 86.332–79 Oxides of nitrogen analyzer calibration.

(a) Perform a converter-efficiency check, (see paragraph (b) of this section), every 7 days. Every 30 days perform a linearity check, (see paragraph (c) of this section), which must be followed by a converter-efficiency check.

(b) *Converter-efficiency check.* The apparatus described and illustrated in Figure D79–4 is to be used to determine the conversion efficiency of devices that convert NO_2 to NO. The following procedure is to be used in determining the values to be used in the equation below:

(1) Follow the manufacturer's instructions for instrument startup and operation.

(2) Zero the oxides of nitrogen analyzer.

(3) Connect the outlet of the NO_x generator (see Figure D79–4) to the sample inlet of the oxides of nitrogen analyzer which has been set to the most common operating range.

(4) Introduce into the NO_x generator-analyzer system a span gas with a NO concentration equal to approximately 80 percent of the most common operating range.

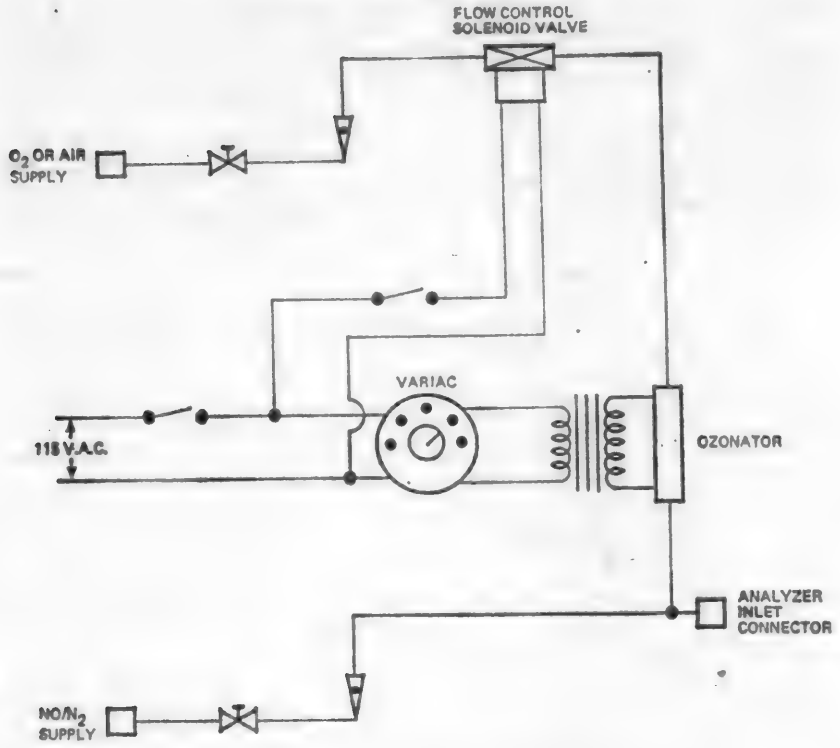

FIGURE D79-4 NO_X CONVERTER EFFICIENCY DETECTOR

(5) With the oxides of nitrogen analyzer in the NO mode, record the concentration of NO indicated by the analyzer.

(6) Turn on the NO. generator O_3 (or air) supply and adjust the O_2 (or air) flow rate so that the NO indicated by the analyzer is about 10 percent less than indicated in step (5). Record the concentration of NO in this NO+O_2 mixture.

(7) Switch the NO_x generator to the generation mode and adjust the generation rate so that the NO measured on the analyzer is 20 percent of that measured in step (5). There must be at least 10 percent unreacted NO at this point. Record the concentration of residual NO.

(8) Switch the oxides of nitrogen analyzer to the NO_x mode and measure total NO_x. Record this value.

(9) Switch off the NO_x generation, but maintain gas flow through the system. The oxides of nitrogen analyzer will indicate the total NO_x in the NO+O_2 mixture. Record this value.

(10) Turn off the NO_x generator O_2 (or air) supply. The analyzer will now indicate the total NO_x in the original NO in N_2 mixture. This value should be no more than 5 percent above the value indicated in step (4).

(11) Calculate the efficiency of the NO_2 converter by substituting the concentrations obtained into the following equation:

$$\text{Percent efficient} = 1 + \frac{a-b}{c-d} \times 100$$

where:
a = concentration obtained in step (8),
b = concentration obtained in step (9),
c = concentration obtained in step (6),
d = concentration obtained in step (7).

The efficiency of the converter shall be greater than 90 percent. Adjustment of the converter temperature may be necessary to maximize the efficiency. If the converter does not meet the conversion-efficiency specifications, repair or replace the unit prior to testing. Repeat the procedures of this section with the repaired or new converter.

(c) *Linearity check.* For each range used, check linearity as follows:

(1) With the operating parameters adjusted to meet the converter efficiency

check and the quench checks, zero the analyzer.

(2) Span the analyzer using a calibration gas that will give a response of approximately 90 percent of full-scale concentration.

(3) Recheck the zero response. If it has changed more than 0.5 percent of full scale, repeat steps (1) and (2).

(4) Record the response of calibration gases having nominal concentrations of 30, 60 and 90 percent of full-scale concentration. It is permitted to use additional concentrations.

(5) Perform a linear least-square regression on the data generated. Use an equation of the form $y=mx$, where x is the actual chart deflection and y is the concentration.

(6) Use the equation $z=y/m$ to find the linear chart deflection (z) for each calibration gas concentration (y).

(7) Determine the linearity ($\%L$) for each calibration gas by:

$$\text{Percent } L=\frac{(z-x)}{\text{Full-scale linear chart deflection}}\times 100$$

(8) The linearity criterion is met if the $\%L$ is less than ± 2 percent for each data point generated. For each emission test, a calibration curve of the form $y=mx$ is to be used. The slope (m) is defined for each range by the spanning process.

(9) If the $\%L$ exceeds ± 2 percent for any data point generated, repair or replace the analyzer or calibration bottles prior to testing. Repeat the procedures of this section with the repaired or replaced equipment or gases.

(10) Perform a converter-efficiency check (see paragraph (b) of this section).

(11) The operating parameters are defined as "optimized" at this point.

§ 86.333–79 Dynamometer calibration.

(a) If necessary, follow the manufacturer's instructions for initial start-up and basic operating adjustments.

(b) Check the dynamometer torque measurement for each range used by the following:

(1) Warm up the dynamometer following the equipment manufacturer's specifications.

(2) Determine the dynamometer calibration moment arm. Equipment manufacturer's data, actual measurement, or the value recorded from the previous calibration used for this subpart may be used.

(3) Calculate the indicated torque (IT) for each calibration weight to be used by:

IT=calibration weight (lb) x calibration moment arm (ft)

(4) Attach each calibration weight specified in § 86.312 to the moment arm at the calibration distance determined in step (2). Record the power measurement equipment response (ft-lb) to each weight.

(5) For each calibration weight, compare the torque value measured in step (4) to the calculated torque determined in step (3).

(6) The measured torque must be within 2 percent of the calculated torque.

(7) If the measured torque is not within 2 percent of the calculated torque, adjust or repair the system. Repeat steps (1) through (6) with the adjusted or repaired system.

(c) *Option.* A master load-cell or transfer standard may be used to verify the in-use torque measurement system.

(1) The master load-cell and read out system must be calibrated with weights at each test weight specified in § 86.312–79. The calibration weights must be traceable to within 0.1 percent of NBS weights.

(2) Warm up the dynamometer following the equipment manufacturer's specifications.

(3) Attach the master load-cell and loading system.

(4) Load the dynamometer to a minimum of 6 equally spaced torque values as indicated by the master load-cell for each in-use range used.

(5) The in-use torque measurement must be within 2 percent of the torque measured by the master system for each load used.

(6) If the in-use torque is not within 2 percent of the master torque, adjust or repair the system. Repeat step (2) through step (5) with the adjusted or repaired system.

(d) The dynamometer calibration must be completed within 2 hours from the completion of the dynamometer warm-up.

§ 86.334–79 Test procedure overview.

(a) The test consists of prescribed sequences of engine operating conditions to be conducted on an engine dynamometer. The exhaust gases generated during engine operation are sampled for specific component analysis through the analytical train. The test is applicable to engines equipped with catalytic or direct-flame afterburners, induction system modifications, or other systems, or to uncontrolled engines.

(b) The tests are designed to determine the brake-specific emissions of hydrocarbons, carbon monoxide, and oxides of nitrogen. The gasoline-fueled engine test consists of 1 warm-up cycle and 1 hot cycle. The Diesel engine test consists of 3 idle modes and 5 power modes at each of 2 speeds which span the typical operating range of Diesel engines. These procedures require the determination of the concentration of each pollutant, the fuel flow and the power output during each mode. The measured values are weighted and used to calculate the grams of each pollutant emitted per brake-horsepower hour.

(c)(1) When an engine is tested for exhaust emissions or is operated for service accumulation on an engine dynamometer, the complete engine shall be tested, with all emission control devices installed and functioning.

(2) Evaporative emission controls need not be connected if data are provided to

show that normal operating conditions are maintained in the engine induction system.

(3) On air cooled engines, the fan shall be installed.

(4) Additional accessories (e.g., oil cooler, alternators, air compressors, etc.) may be installed with advance approval by the Administrator.

(d) All emission control systems installed on or incorporated in a new motor vehicle engine shall be functioning during all procedures in this subpart. In cases of component malfunction or failure, maintenance to correct component failure or malfunction shall be authorized in accordance with § 86.-079–25.

§ 86.335–79 Gasoline-fueled engine test cycle.

(a) The following test sequence shall be followed in dynamometer operation tests of gasoline-fueled heavy-duty engines. Diesel engines are covered in § 86.-336.

Cycle No.	Mode No.	Mode	Observed torque (percent of maximum observed)	Time in mode-seconds	Cumulative time-seconds	Weighting factors
1	1	Idle		60	60	0.043
1	2	Cruise	25	60	120	.077
1	3	PTA	55	60	180	.147
1	4	Cruise	25	60	240	.077
1	5	PTD	10	60	300	.057
1	6	Cruise	25	60	360	.077
1	7	FL	90	60	420	.113
1	8	Cruise	25	60	480	.077
1	9	CT		60	540	.143
2	10	Cruise	25	60	600	.077
2	11	PTA	55	60	660	.147
2	12	Cruise	25	60	720	.077
2	13	PTD	10	60	780	.057
2	14	Cruise	25	60	840	.077
2	15	FL	90	60	900	.113
2	16	Cruise	25	60	960	.077
2	17	CT		60	1,020	.143
2	18	Idle		60	1,080	.232

(b) Except for idles, the engine dynamometer shall be operated at a constant speed of 2000 rpm±100 rpm. Speed deviations, not to exceed 200 rpm, will be allowed during the first 10 seconds of each mode.

(c) The times in-mode specified in paragraph (a) for the CT modes are ±2 seconds. All other times in-mode are ±4 seconds.

(d) Torque for each mode must be held at the specified value ±2 percent of the maximum torque observed except for the first 20 seconds of each mode. For example, mode 3 torques shall be held between 53 and 57 percent of maximum torque (55 ±2%).

(e) The idle operating mode shall be carried out at the manufacturer's recommended curb-idle engine speed. Arrive at the last idle mode by closing the throttle, braking the dynamometer to the engine idle speed, and unloading the dynamometer.

(f) The CT operating mode shall be carried out at the same engine speed as specified in paragraph (b) of this section.

(g) If the Administrator determines that an engine shall be tested as an automatic transmission code engine, then a load shall be applied by the dynamometer during the idle modes (1 and 18) such that the engine speed is decreased from the recommended dynamometer-idle speed to the recommended curb-idle speed. The engine idle torque recorded for the calculations in § 86.345 shall be zero.

(h) If the operating conditions specified in paragraph (a) of this section for modes 2 through 8, and 10 through 16 cannot be maintained, the Administrator may authorize deviations from the specified load conditions. Such deviations shall not exceed 5 percent of the maximum torque at the test speed. The minimum deviations, above and below the specified load, necessary for stable operation shall be determined by the manufacturer and approved by the Administrator prior to the test run. Emission tests shall be performed by operating the engine at the higher approved load setting during cycle 1 and at the lower approved load setting during cycle 2. The weighting factors shall be as specified in paragraph (a) of this section.

§ 86.336–79 Diesel engine test cycle.

(a) The following 13-mode cycle shall be followed in dynamometer operation tests of heavy-duty Diesel engines. Gasoline-fueled engines are covered in § 86.-335.

Test Segment	Mode No.	Engine Speed	Observed torque (percent of maximum observed)	Time in mode (minutes) Minimum	Maximum	Maximum cumulative time (minutes)
1	1	Curb-idle		4.5	6.0	
1	2	Intermediate	2	4.5	6.0	
1	3	do	25	4.5	6.0	
1	4	do	50	4.5	6.0	42
1	5	do	75	4.5	6.0	
1	6	do	100	4.5	6.0	
1	7	Curb-idle		4.5	6.0	
2	8	Rated	100	4.5	6.0	
2	9	do	75	4.5	6.0	
2	10	do	50	4.5	6.0	36
2	11	do	25	4.5	6.0	
2	12	do	2	4.5	6.0	
2	13	Curb-idle		4.5	6.0	

(b) During each mode the specified speed shall be held to within 50 rpm. Torque for each mode must be held at the specified value ±2 percent of the maximum torque observed. For example, mode 4 torque shall be held between 48 and 52 percent of maximum torque (50 ±2%).

(c) If the operating conditions specified in paragraph (b) of this section for modes 3, 4, 5, 9, 10, and 11 cannot be maintained, the Administrator may authorize deviations from the specified load conditions. Such deviations shall not exceed 10 percent of the maximum torque at the test speed. The minimum deviations, above and below the specified load, necessary for stable operation shall be determined by the manufacturer and approved by the Administrator prior to the test run. Emission tests shall be performed at each of the approved load settings, one above and one below the operating conditions specified in paragraph (a) of this section. The emission values obtained shall be calculated in accordance with § 86.345 except that the weighting factor shall be 0.04.

(d) If the Administrator determines that an engine shall be tested as an automatic transmission code engine, then a load shall be applied by the dynamometer during the idle modes (1, 7, and 13) such that the engine speed is decreased from the recommended dynamometer-idle speed to the recommended curb-idle speed. The engine-idle torque recorded for the calculations in § 86.345 shall be zero.

§ 86.337–79 Information.

The following information, as applicable, shall be recorded for each test:

(a) *Engine description and specification.* A copy of the information specified in this paragraph must accompany each engine sent to the Administrator for compliance testing. The manufacturer need not record the information specified in this paragraph for each test if the information, with the exception of subparagraphs (3), (12), and (13), is included in the manufacturer's Part I.

(1) Engine-system combination.

(2) Engine identification number.

(3) Number of hours of operation accumulated on engine.

(4) Rated maximum horsepower and torque.

(5) Maximum horsepower and torque speeds.

(6) Engine displacement.

(7) Governed speed.

(8) Manufacturer's start-up and warm-up reference, gasoline-fueled engines only).

(9) Curb-idle rpm.

(10) Dynamometer-idle rpm (automatic transmission code engines only).

(11) Maximum horsepower at 2000 rpm (gasoline-fueled engines only).

(12) Fuel consumption and maximum torque at 2000 rpm (gasoline-fueled engines only).

(13) Fuel consumption at maximum power and torque (Diesel engines only).

(14) Maximum air flow (Diesel engines only).

(15) Air inlet restriction (Diesel engines only).

(16) Exhaust pipe diameter(s) (Diesel engines only).

(17) Maximum exhaust system back pressure (Diesel engines only).

(18) Maximum exhaust system back pressure at 2000 rpm, if applicable (gasoline-fueled engines only).

(b) *Test data; general.* This information may be recorded at any time between 4 hours prior to the test and 4 hours after the test.

(1) Engine-system combination.

(2) Engine identification number.

(3) Instrument operator.

(4) Engine operator.

(5) Number of hours of operation accumulated on the engine prior to beginning the warm-up portion of the test.

(6) Fuel identification, including H/C ratio.

(7) Date of most recent analytical assembly calibration.

(8) All pertinent instrument information such as tuning, gain, serial numbers, detector number, calibration curve numbers, etc. As long as this information is traceable, it may be summarized by system number or analyzer identification numbers.

(c) *Test data; pre-test.* (1) Date and time of day.

(2) Test number.

(3) Ambient temperature in dynamometer testing room (gasoline-fueled engines only).

(4) Barometric pressure, pre-test for gasoline-fueled engines, pre-test segment for Diesel engines.

(5) Engine intake humidity, pre-test for gasoline-fueled engines, pre-test segment for Diesel engines with nonconditioned air supply systems.

(6) Maximum observed torque for intermediate and rated speeds (Diesel engines only).

(7) Maximum observed torque at 2000 rpm (gasoline-fueled engines only).

(8) Recorder chart or equivalent. Identify for each test (test segment for Diesel engines) zero traces for each range used, and span traces for each range used.

(d) *Test data; modal.* (1) Recorder chart or equivalent. Identify for each test mode the emission concentration traces and the associated analyzer range(s). The start and finish of each test.

(2) Observed engine torque.

(3) Observed engine rpm.

(4) Record engine torque and engine rpm continuously with a chart recorder or equivalent recording device.

(5) Intake air flow and depression for each mode (Diesel engines only).

(6) Engine intake air temperature for each mode (Diesel engines only).

(7) Fuel flow for each mode. If the fuel flow measurement is a volume measurement system, record the fuel temperature in the measurement system for fuel density corrections to the mass flow rate. If the fuel temperature is within 3°C (5.4° F) of the calibration temperature, no density correction is required.

(8) Engine intake humidity (only for Diesel engines with humidity conditioned air supply).

(e) *Test data; post-test.* (1) Recorder chart or equivalent. Identify the hang-up check.

(2) Recorder chart or equivalent. Identify the zero traces for each range used and the span traces for each range used.

(3) Ambient temperature in the dynamometer testing room (gasoline-fueled engines only).

(4) Total number of hours of operation accumulated on the engine.

§ 86.338–79 Exhaust measurement accuracy.

(a) The analyzers must be operated between 15 percent and 100 percent of full-scale chart deflection during the measurement of the emissions for each mode. The exceptions to the lower limit of this operating rule are:

(1) The analyzer's response may be less than 15 percent of full scale if the full-scale value is 120 ppm (or ppmC) or less.

(2) *Option.* For CO analysis the analyzer's response may be less than 15 percent of full scale if the full-scale value is 5500 ppm or less.

(3) The analyzer's response may be less than 15 percent of full scale if the emissions from the engine are erratic and the average chart-deflection value is greater than 15 percent of full scale.

(4) For gasoline-fueled engines, the analyzer's response may be less than 15 percent of full scale during the initial part of the CT mode provided that the average chart-deflection value is greater than 15 percent of full scale.

(5) The analyzer's response may be less than 15 percent of full scale if the contribution of all modes read below the 15 percent level is less than 10 percent by mass of the final test results.

§ 86.339–79 Pre-test procedures.

(a) Allow a minimum of 30 minutes warm-up in the stand-by or operating mode prior to spanning the analyzers.

(b) Replace or clean the filter elements and then vacuum leak check the system, §86.328(a). A pressure leak check is also permitted per §86.328(b). Allow the heated sample line, filters, and pumps to reach operating temperature.

(c) Perform the following system checks:

(1) If a stainless steel NO_2 to NO converter is used, prior to gasoline-fueled engine tests, purge the converter with air (zero-grade air, room air, or O_2) for a minimum of 30 minutes. The converter must be at operational temperature while purging.

(2) Check the sample-line temperature (see §86.310).

(3) Check the system response time (see §86.329). System response time may be applied from the most recent check of response time if all of the following are met:

(i) The flow rate for each flow meter is equal to or greater than the flow rate recorded in §86.329(b)(1)(ii).

(ii) For analyzers with capillaries, the response time from the sample/span valve is measured using in-use pressures and bypass flows (see § 86.329(b)(2)).

(iii) The response time measured in step (ii) is equal to or less than the response time determined in § 86.329(b)(2)(vii).

(4) A hang-up check is permitted.

(5) A converter-efficiency check is permitted. The check need not conform to § 86.332(b). The test procedure may be aborted at this point in the procedure in order to repair the NO_2 to NO converter. If the test is aborted, the converter must pass the efficiency check described in § 86.332(b) prior to starting the dynamometer test run.

(d) Introduce the zero-grade gases at the same flow rates and pressures used to calibrate the analyzers and zero the analyzers on the lowest anticipated range that will be used during the test. Immediately prior to each test (segment, for Diesel engines), obtain a stable zero for each anticipated range that will be used during the test.

(e) Introduce span gases to the instruments under the same flow conditions as were used for the zero gases. Adjust the instrument gains on the lowest range that will be used to give the desired value. Span gases should have a concentration greater than 70 percent of full scale for each range used. Immediately prior to each test and also prior to each segment of the Diesel test, record the response to the span gas and the span-gas concentration for each range that will be used during the test.

(f) Check the zero responses. If they have changed more than 0.5 percent of full scale, repeat paragraphs (d) and (e) of this section.

(g) Check system flow rates and pressures. Note the values of gauges G3 and G4 for reference during the test.

§ 86.340–79 Gasoline-fueled engine dynamometer test run.

(a) This section applies to gasoline-fueled engines only. Diesel engines are covered in § 86.341.

(b) (1) Mount test engine on the engine dynamometer.

(2) Install instrumentation and sample probe.

(3) Read and record the general test data as specified in § 86.337(b).

(c) Precondition the engine by the following continuous steps:

(1) The engine shall be started and operated at:

(i) Zero load in accordance with the manufacturer's start-up and warm-up procedures for 1 minute ±30 sec;

(ii) A torque equivalent to 10±3 percent of the most recent determination of maximum torque for 4 minutes ±30 sec at 2000 rpm;

(iii) A torque equivalent to 55±5 percent of the most recent determination of maximum torque for 35 minutes ±1 minute at 2000 rpm;

(iv) Option. If the engine has been operating on service accumulation for a minimum of 40 minutes, the service accumulation may be substituted for steps (i) through (iii).

(2) If tested under the provisions of § 86.079–29, check specifications as required. This check must be performed within 10 minutes after completion of engine preconditioning;

(3) Determine the maximum torque of the engine at 2000 rpm±100 rpm;

(i) Operate the engine with the throttle fully opened for a maximum of three minutes. During the second minute of operation, record the high and low torque readings. The average of these two readings will be the maximum torque value at 2000 rpm.

(ii) Calculate the torque corresponding to 10, 25, 55, and 90 percent of the observed maximum torque value.

(4) Determine the analyzer ranges required for each mode specified in § 86.335 to meet the range specifications of § 86.338. The engine must not be operated for more than 10 minutes. Cycle 1, specified in § 86.335, may be used for this purpose;

(5) The engine shall be turned off and allowed to stand for at least 1 hour, but not more than 2 hours, at an average ambient temperature of 25° C±5° C (77° F±9° F).

(d) The following steps shall be taken for each test:

(1) Maintain dynamometer test cell average ambient temperature at 25° C± 5° C (77°F±9°F);

(2) Observe pre-test procedures; § 86.339;

(3) Start cooling system;

(4) Start engine and operate in accordance with manufacturer's start-up and warm-up procedures. The duration of the warm-up procedure shall be 5 minutes ±30 seconds. Sample flow may begin during the warm-up;

(5) Read and record all pre-test data specified in § 86.337(c) during the 5-minute warm-up;

(6) Release the choke idle-stop (if necessary) and return the engine throttle control to the curb-idle position, start sample flow and recorders if not already started, and begin test sequence of § 86.335;

(7) Should it be determined that the test must be rerun, then only the soak specified in paragraph (c)(5) of this section need be performed prior to paragraph (d) of this section;

(8) Perform the test cycle, § 86.335, and continuously record exhaust gas concentrations;

(9) Read and record all modal data specified in § 86.337(d) during the test cycle;

(10) The engine speed and load must be maintained within the requirements of § 86.343;

(11) If at any time during a test, the test equipment malfunctions or the specifications in paragraph (d)(10) of this section are not met, the test is void, and may be aborted. The test sequence may be restarted under the provisions of paragraph (c)(5) of this section.

(e) *Exhaust gas measurements.* (1) Measure HC, CO, CO_2, and NOx volume concentration in the exhaust sample. Should the analyzer response exceed 100 percent of full scale or respond less than 15 percent of full scale, the next higher or lower analyzer range shall be used per § 86.338. For exceptions to the lower limit see § 86.338. Should the fuel flow instrument read below 20 percent of the full-scale value, a flow measurement unit with a lower scale must be used unless the option in § 86.314 is desired.

(2) For each analyzer, each range that may be used during a test must have the zero and span responses recorded prior to the execution of that test. Only the range(s) used to measure the emissions during a test are required to have their

zero and span recorded after the completion of the test.

(3) If during an emission test the value of gauges downstream of the NDIR analyzer(s) (G3 or G4) differs by more than ±2 inches of water from the pre-test value, the test is void.

§ 86.341–79 Diesel engine dynamometer test run.

(a) This section applies to Diesel engines only. Gasoline-fueled engines are covered in § 86.340.

(b) The temperature of the air supplied to the engine shall be between 68° F and 86° F. The fuel temperature at the pump inlet shall be 100° F±10° F. The observed barometric pressure shall be between 28.5 inches and 31 inches Hg. Higher air temperature or lower barometric pressure may be used, if desired, but no allowance shall be made for increased emissions because of such conditions.

(c) The governor and fuel system shall have been adjusted to provide engine performance at the levels in the application for certification required under § 86.079–21. These adjustments are only permitted under the provisions of § 86.-079–25.

(d) The following steps shall be taken for each test:

(1) Install instrumentation and sample probes as required;

(2) Observe pre-test procedure, § 86.-339;

(3) Read and record the general test data as specified in § 86.337(b);

(4) Start cooling system;

(5) Precondition the engine in the following manner:

(i) Operate the engine at idle for 2 to 3 minutes;

(ii) Operate the engine at approximately 50 percent power at the peak torque speed for 5 to 7 minutes;

(iii) Operate the engine at rated speed and maximum horsepower for 25 to 30 minutes;

(iv) *Option.* It is permitted to precondition the engine at rated speed and maximum horsepower until the oil and water temperatures are stabilized. The temperatures are defined as stabilized if they are maintained within 2 percent of point for 2 minutes. The engine must be operated a minimum of 10 minutes for this option. This optional procedure may be subsituted for step (iii);

(v) *Option.* If the engine has been operating on service accumulation for a minimum of 40 minutes, the service accumulation may be substituted for steps (i) through (iii);

(vi) Longer preconditioning times may be used only if prior approval is obtained from the Administrator.

(6) Within a total elapsed time of 10 minutes or less, determine by experimentation the maximum torque at the rated and intermediate speeds;

(7) Calculate the torque corresponding to 2, 25, 50, 75, and 100 percent of the maximum observed torque for the rated and intermediate speeds;

(8) Read and record all pre-test data specified in § 86.337(c);

(9) Start the test cycle, § 86.336, within 10 minutes, after determining test load using the torque values determined in paragraph (d)(6) of this section;

(10) Read and record all modal data specified in § 86.337(d) during the last 2 minutes of each mode;

(11) Continuously record the analyzer's response to the exhaust gas during each test segment;

(12) Test segments may be repeated;

(13) If a delay of more than 20 minutes occurs between the end of one segment and the beginning of another segment the test is void. The test may be restarted at paragraph (d)(8) of this section. If the delay exceeds 4 hours, the test shall be restarted at paragraph (d)(2) of this section;

(14) The engine speed and load must be maintained within the requirements of § 86.336 during the last 2 minutes of each mode. If the requirement is not met for all modes during a test segment, that segment of the test is void. The test segment may be restarted beginning with paragraph (d)(8) of this section;

(15) If at any time during a test segment, the test equipment malfunctions or the specifications in paragraph (d)(14) of this section are not met, the test segment is void, and may be aborted. The test segment may be restarted beginning with paragraph (d)(8) of this section;

(16) Fuel flow and air flow during the idle or 2-percent load conditions may be determined just prior to or immediately following the dynamometer sequence, if longer times are required for accurate measurements.

(e) *Exhaust gas measurements.* (1) Measure HC, CO, CO_2, and NO_x volume concentration in the exhaust sample. Should the analyzer response exceed 100 percent of full scale or respond less than 15 percent of full scale, the next higher or lower analyzer range shall be used per § 86.338. For exceptions to the lower limit see § 86.338. Should the fuel flow instrument read below 20 percent of full-scale value, a smaller flow measurement unit must be used unless the option in § 86.314 is desired.

(2) Each analyzer range that may be used during a test segment must have the zero and span responses recorded prior to the execution of that test segment. Only the range(s) used to measure the emissions during a test segment are required to have their zero and span recorded after the completion of the test segment.

(3) It is permitted to change filter elements between test segments.

(4) A leak check is permitted between test segments.

(5) A hang-up check is permitted between test segments.

(6) If, during the emission measurement portion of a test segment, the value of the gauges downstream of the NDIR analyzer(s) G3 or G4 differs by more than ±2 inches of water from the pre-test value, the test segment is void.

§ 86.342–79 Post-test procedures.

(a) Begin a hang-up check within 30 seconds of the completion of the last mode in the test. Use the following procedure:

(1) Introduce a zero-grade gas into the sample probe or valve V2 to check the "hang-up zero" response. Simultaneously start a time measurement;

(2) Select the lowest HC range used during the test;

(3) The difference between the span-zero response and the hang-up zero response shall not be greater than 5.0 percent of full scale or 10 ppmC whichever is greater, within:

(i) 50 seconds for gasoline-fueled engine tests, or

(ii) 4 minutes for Diesel engine tests;

(b) Begin the analyzer span checks within 6 minutes after the completion of the last mode in the test. Record for each analyzer the zero and span response for each range used during the preceding test or test segment.

(c) If during the test, the filter element(s) were replaced or cleaned, a vacuum check must be performed per § 86.328 immediately after the span checks. If the vacuum side leak check does not meet the requirements of § 86.328 the test is void.

(d) Read and record the post-test data specified in § 86.337(e).

(e) For a valid test, the analyzer drift between the before-test and after-test (before-segment and after-segment for Diesels) span checks for each analyzer must meet the following requirements:

(1) The span drift (defined as the change in the difference between the zero response and the span response) must not exceed 2.0 percent of full-scale chart deflection for each range used;

(2) The zero response drift must not exceed 2.0 percent of full-scale chart deflection for each range used.

§ 86.343–79 Chart reading.

(a) A computer or any other automatic data processing device(s) may be used as long as the system meets the requirements of this subpart.

(b) Determine the location on the chart of the analyzer responses corresponding to the end of each mode.

(c) For gasoline-fueled engines, determine whether the test cycle was run in accordance with § 86.335 by observing either chart event marks, speed trace, torque trace, or concentration traces. The test will be invalidated if there is a deviation of more than:

(1) 2 seconds from the specified time for each CT mode, and 4 seconds for all other modes; or,

(2) 2 percent of maximum torque during each mode excluding the first 20 seconds of each mode; or,

(3) 200 rpm during the first 10 seconds of each mode, or 100 rpm during the remainder of each mode.

(d) Determine chart deflections.

(1) Locate the last 10 seconds of each gasoline-fueled engine mode except CT. Locate the last 50 seconds of each gasoline-fueled engine CT mode. For all Diesel engine modes locate the last 60 seconds.

(2) (i) Divide the last 10 seconds or 60 seconds, whichever is applicable, into a minimum of 10 equally spaced incre-

ments. Determine the chart deflection of each increment for the CO_2, CO, HC, and NO_x analyzers.

(ii) Option for Diesel engine modes. If the deviation from a straight line (other than instrument noise) during this 60 seconds is less than ±5 percent of full-scale, the average chart deflection may be determined by eye. The average value (one number) may then be used in lieu of the 10 values required by paragraph (d)(2)(i) of this section.

(3) Other methods of determining the chart deflection of the analyzers may be used only with prior approval by the Administrator.

(e) Determine CO_2, CO, HC, and NO_x concentrations for each mode.

(1) If the option in paragraph (d)(2)(ii) of this section is employed, then those chart deflections for both linear and non-linear analyzers may be substituted for the average chart deflection in step (e)(2).

(2) For linear instruments, average the chart deflections determined in paragraph (d)(2)(i) of this section. Determine the concentration for this average chart deflection using calibration data.

(3) For non-linear instruments, calculate concentrations for each chart deflection determined in paragraph (d)(2)(i) of this section. Take the average of these concentrations for each mode.

(4) For purposes of this paragraph, calibration data includes calibration curves, linearity curves, span-gas responses, and zero-gas responses.

§ 86.344–79 Humidity calculations.

(a) The following abbreviations (and units) are used in this section:

$BARO$ = barometric pressure (Pa)
H = specific humidity, (gm H_2O/gm of dry air)
K = 0.6220 gm H_2O/gm dry air
M_{air} = Molecular weight of air = 28.9645
M_{H_2O} = Molecular weight of water = 18.01534
P_{DB} = Saturation vapor pressure of water at the dry bulb temperature (Pa)
P_{DP} = saturation vapor pressure of water at the dew-point temperature (Pa)
P_v = partial pressure of water vapor (Pa)
P_{WB} = saturation vapor pressure of water at the wet bulb temperature (Pa)
T_{DB} = Dry bulb temperature (°K)
T_{WB} = Wet bulb temperature (°K)
Y = Water-vapor volume concentration

(b) The specific humidity on a dry basis of the intake air (H) is defined by equation (1).

$$H=\frac{(K)(P_v)}{BARO-P_v} \quad (1)$$

(c) The partial pressure of water vapor may be determined in two manners:

(1) A dew point device may be used. In that case:

$$P_v=P_{DP}$$

(2) A wet-bulb, dry-bulb method may be used. In that case "Ferrels equation" (eq. (2)) is used.

$$P_v=P_{WB}-0.000660\ (T_{DB}-T_{WB})\ BARO\ [1+0.00115\ (T_{WB}-273.15)] \quad (2)$$

(d)(1) The saturation vapor pressure (P_{WB}) of water at the wet-bulb temperature is defined by equation (3) (Ref. Wexler and Greenspan, equation (23), National Bureau of Standards).

$$P_{WB}=\exp\left[B\ln T_{WB}+\sum_{i=0}^{9}F_i T_{WB}^{i}\right] \quad (3)$$

where:
P_{WB} is in Pascals (Pa)
T_{WB} = Wet-bulb temperature (°K)
$B=-12.150799$
$F_0=-8.40922(10)^3$
$F_1=-7.4221865(10)^1$
$F_2=96.1635147$
$F_3=2.4917646(10)^{-2}$
$F_4=-1.2160119(10)^{-5}$
$F_5=-1.1460454(10)^{-8}$
$F_6=2.1701289(10)^{-11}$
$F_7=-3.610258(10)^{-14}$
$F_8=3.8504519(10)^{-17}$
$F_9=-1.4317(10)^{-20}$

(2) The table in Figure D79–5 may be used in lieu of equation (3).

(e) The saturated vapor pressure of water at the dry-bulb temperature (P_{DB}) is found (if required) by using dry-bulb absolute termperature (°K) in equation (3).

(f) The percent of relative humidity (RH) (if required) is defined by equation (4).

$$RH=\frac{P_v}{P_{DB}}(100) \quad (4)$$

(g) The water-vapor volume concentration on a dry basis of the engine intake air (Y) is defined by equation (5).

$$Y=\frac{(H)(M_{air})}{(M_{H_2O})}=\frac{P_v}{BARO-P_v} \quad (5)$$

Figure D79- 5

Saturation Vapor Pressure Over Water (pascals)

Temperature deg C	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0	610.752	615.207	619.690	624.203	628.744	633.315	637.916	642.545	647.205	651.894
1	656.614	661.364	666.144	670.955	675.796	680.669	685.572	690.507	695.473	700.471
2	705.500	710.562	715.655	720.781	725.939	731.130	736.354	741.611	746.901	752.224
3	757.581	762.971	768.396	773.854	779.347	784.874	790.436	796.033	801.664	807.331
4	813.034	818.771	824.545	830.355	836.200	842.082	848.001	853.956	859.948	865.978
5	872.045	878.149	884.291	890.470	896.688	902.945	909.239	915.573	921.945	928.357
6	934.808	941.298	947.828	954.399	961.009	967.660	974.351	981.083	987.856	994.670
7	1001.53	1008.42	1015.36	1022.34	1029.37	1036.43	1043.54	1050.70	1057.89	1065.13
8	1072.41	1079.74	1087.11	1094.52	1101.98	1109.48	1117.03	1124.63	1132.27	1139.95
9	1147.68	1155.46	1163.28	1171.15	1179.07	1187.04	1195.05	1203.11	1211.21	1219.37
10	1227.57	1235.83	1244.13	1252.48	1260.88	1269.32	1277.82	1286.37	1294.97	1303.62
11	1312.32	1321.07	1329.87	1338.73	1347.63	1356.59	1365.60	1374.67	1383.78	1392.95
12	1402.17	1411.45	1420.78	1430.16	1439.60	1449.10	1458.64	1468.25	1477.91	1487.62
13	1497.39	1507.22	1517.11	1527.05	1537.04	1547.10	1557.21	1567.39	1577.62	1587.90
14	1598.25	1608.66	1619.12	1629.65	1640.24	1650.88	1661.59	1672.36	1683.18	1694.08
15	1705.03	1716.04	1727.12	1738.26	1749.46	1760.73	1772.06	1783.45	1794.91	1806.43
16	1818.01	1829.67	1841.38	1853.17	1865.02	1876.93	1888.91	1900.96	1913.08	1925.27
17	1937.52	1949.84	1962.23	1974.69	1987.21	1999.81	2012.48	2025.21	2038.02	2050.90
18	2063.85	2076.87	2089.97	2103.13	2116.37	2129.68	2143.07	2156.53	2170.06	2183.66
19	2197.34	2211.10	2224.93	2238.84	2252.82	2266.88	2281.02	2295.23	2309.52	2323.89

Figure D79-5, Continued

Temperature deg C	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
20	2338.34	2352.86	2367.47	2382.15	2396.91	2411.76	2426.68	2441.68	2456.77	2471.93
21	2487.18	2502.51	2517.93	2533.42	2549.00	2564.66	2580.41	2596.24	2612.16	2628.16
22	2644.25	2660.42	2676.68	2693.02	2709.46	2725.98	2742.59	2759.28	2776.07	2792.94
23	2809.91	2826.96	2844.11	2861.34	2878.67	2896.09	2913.60	2931.20	2948.89	2966.68
24	2984.56	3002.54	3020.61	3038.77	3057.03	3075.39	3093.84	3112.39	3131.03	3149.78
25	3168.62	3187.55	3206.59	3225.73	3244.96	3264.30	3283.73	3303.27	3322.91	3242.65
26	3362.49	3382.43	3402.48	3422.63	3442.89	3463.24	3483.71	3504.28	3524.95	3545.73
27	3566.62	3587.62	3608.72	3629.93	3651.25	3672.67	3694.21	3715.86	3737.61	3759.48
28	3781.46	3803.55	3825.75	3848.07	3870.50	3893.04	3915.70	3938.47	3961.36	3984.36
29	4007.48	4030.71	4054.06	4077.53	4101.12	4124.83	4148.65	4172.59	4196.66	4220.84
30	4245.15	4269.58	4294.13	4318.80	4343.60	4368.52	4393.56	4418.73	4444.02	4469.44

§ 86.345–79 Emission calculations.

(a) The following abbreviations (and units) are used in this section.

α = atomic hydrogen/carbon ratio of the fuel
ϕ = dry fuel-air ratio (measured)/fuel-air ratio (stoichiometric)
BARO = Barometric pressure (in. *HgA*)
BHP = Brake horsepower
BSCO = Brake specific carbon monoxide emissions, (gm/*BHP-HR*)
BSFC = Brake specific fuel consumption (lb/*BHP-HR*)
BSHC = Brake specific hydrocarbon emissions (gm/*BHP-HR*)
$BSNO_x$ = Brake specific oxides of nitrogen emissions (gm/*BHP-HR*)
DCO = CO volume concentration in exhaust, ppm (dry)
DCO_2 = CO_2 volume concentration in exhaust, percent (dry)
DHC = HC volume carbon concentration in exhaust, ppmC (dry)
DKNO = NO volume concentration in exhaust, in ppm (dry and humidity corrected)
EIP = engine intake pressure (in. *HgA*) = *BARO* − inlet depression
f/a = measured dry fuel-air ratio
G = humidity of the inlet air in grains of water per pound of dry air = (453.59/0.0648) *H*, (see § 86.344)
K = water–gas equilibrium constant = 3.5
K_{NO_x} = Humidity correction factor for oxides of nitrogen
K_w = Wet to dry correction factor
M_C = Atomic weight of carbon
(M_C+M_H) = mean molecular weight of the fuel per carbon atom
M_{CO} = Molecular weight of CO
M_f = Mass flow-rate of fuel used in the engine in lb/hr = W_f/453.59
M_H = Atomic weight of hydrogen
M_{NO_2} = Molecular weight of nitrogen dioxide (NO_2)
T = Temperature of inlet air (°F)
W_{CO} = Mass rate of CO in exhaust, grams/hr
W_f = Mass flow-rate of fuel used in the engine, in grams/hr = (453.59) x (W_f lbs/hr)
WHC = HC volume concentration in exhaust, ppm *C* (wet)
W_{HC} = Mass rate of HC in exhaust, grams/hr
W_{NO_x} = Mass rate of NO_x in exhaust, grams/hr
Y = H_2O volume concentration of intake air (See § 86.344)

(b) Determine the exhaust species volume concentration for each mode.

(c) (1) Convert wet basis measurements to a dry basis by the following:

Dry concentrations = $1/K_w$ x wet concentrations. K_w is defined by the equation in Figure D79–6.

(2) For Diesel engines, for each mode use the measured engine (*f/a*) entering the combustion chamber when calculating ϕ. If applicable bleed air, etc. must be subtracted from the measured air flow (see § 86.313).

(3) For gasoline-fueled engines, optional for Diesel engines, calculate ϕ for each mode by substituting *WHC* for *DHC* in the (*f/a*) equations in paragraph (d) of this section.

(4) Calculate a *Y* value for each gasoline-fueled engine test from the pre-test data. Apply the *Y* value to the K_w equation for the entire test.

(5) Calculate a separate *Y* value for each Diesel test segment from the pre-test-segment data. Apply the *Y* value to the K_w equation for the entire test-segment.

$$K_w = \frac{1}{\left[\phi\left(\frac{DCO_2}{10^2}+\frac{DCO}{10^6}\right)+\frac{2Y}{a}\left(\frac{DCO_2}{10^2}+\frac{DCO}{10^6}+\frac{WHC}{10^6}\right)\left(1+\frac{a}{4}\right)\right]\left[1+\frac{2\left(1+\frac{DCO}{10^6}\right)}{\left(\frac{DCO_2}{10^2}\right)K}\right]}$$

Figure D79-6 K_w = WET TO DRY CORRECTION FACTOR

(d) Compute the dry (*f/a*) if required as follows:

$$(f/a) = \frac{4.77\,(1+\alpha/4)\,(f/a)\ \text{stoich}}{\frac{1}{\overline{X}}-\left(\frac{DCO}{2\,\overline{X}\,(10)^6}\right)-\left(\frac{DHC}{\overline{X}\,10^6}\right)+\frac{\alpha}{4}\left(1-\frac{DHC}{\overline{X}\,(10^6)}\right)-\frac{.75\alpha}{\left(\frac{K}{\frac{DCO}{\overline{X}\,(10)^6}}\right)+\left(\frac{(1-K)}{1-\frac{DHC}{\overline{X}\,(10)^6}}\right)}}$$

$$(f/a)\ \text{stoich} = \frac{M_C+\alpha M_H}{138.18\,(1+\alpha/4)}$$

where

$$\overline{X} = DCO_2/10^2 + DCO/10^6 + DHC/10^6$$

(e) *Data validation*—(1) *Diesel engines only.* Compare the calculated dry (*f/a*) with the measured fuel and air flow. For a valid test the emission calculated (*f/a*) must agree within 10 percent of the measured (*f/a*) for each mode. Diesel engine idle and 2 percent modes do not have to meet this requirement.

(2) *Fuel/Air ratio comparison.* When comparing measured (*f/a*) ratio to an emissions calculated (*f/a*) ratio, the measured air flow (in terms of mass) is the total mass of air entering the exhaust pipe. This may include additions of air mass to the exhaust pipe by an air injection system.

(3) Other methods of data validation may be used if prior approval is obtained from the Administrator.

(4) Data validation techniques that have obtained prior approval from the Administrator for use on gasoline-fueled engines may be used to determine void tests.

(f) Multiply the dry nitric oxide volume concentrations by the following humidity correction factor to obtain *DKNO:*

(1) Gasoline-fueled engines:

$$K_{NOx} = 0.6272 + 0.00629G - 0.0000176G^2$$

(2) Diesel engines:

$$K_{NO_x} = \frac{1}{1+A\,(G-75)+B\,(T-85)}$$

where:

$A = 0.044\,(f/a) - 0.0038$
$B = -0.116\,(f/a) + 0.0053$
T = Temperature of inlet air, °F.

(g) Calculate the mass emissions of each species in grams per hour for each mode as follows:

(1) $$\text{HC grams/hr} = W_{HC} = \frac{(DHC/10^4)\,W_f}{(DCO/10^4)+DCO_2+(DHC/10^4)}$$

(2) $$\text{CO grams/hr} = W_{CO} = \frac{M_{CO}\,(DCO/10^4)\,W_f}{(M_C+\alpha M_H)\,[(DCO/10^4)+DCO_2+(DHC/10^4)]}$$

(3) $$\text{NO}_x\ \text{grams/hr} = W_{NO_x} = \frac{M_{NO_2}\,(DKNO/10^4)\,W_f}{(M_C+\alpha M_H)\,[(DCO/10^4)+DCO_2+(DHC/10^4)]}$$

(h) (1) For gasoline-fueled engines, weight the mass values of *BHIP*, W_{HC}, W_{CO}, M_f, and W_{NOx} for each mode by multiplying the modal mass values by the appropriate modal weighting factor prescribed by § 86.335.

(2) For Diesel engines, weight the values of *BHP*, W_{HC}, W_{CO}, W_{NOx}, and M_f as follows:

(i) Weight the values from each idle mode by multiplying the values by (0.067);

(ii) Weight the remaining modes by multiplying the values by 0.08.

(i) Calculate the brake specific emissions for:

(1) Each gasoline-fueled engine test cycle, and

(2) Each Diesel engine test by summing the weighted values (*BHP*, W_{HC}, W_{CO}, and W_{NOx}) from each mode as follows:

$$BSHC(t) = \frac{\Sigma \text{ weighted } W_{HC}}{\Sigma \text{ weighted } BHP}$$

$$BSCO(t) = \frac{\Sigma \text{ weighted } W_{CO}}{\Sigma \text{ weighted } BHP}$$

$$BSNOx(t) = \frac{\Sigma \text{ weighted } W_{NOx}}{\Sigma \text{ weighted } BHP}$$

(t)=Test cycle number (t=1, 2) (gasoline-fueled engines only).

(j) (1) Calculate the brake-specific fuel consumption (*BSFC*) from the non-weighted *BHP* and M_f for each mode. Gasoline-fueled engine idle and *CT* modes, and Diesel idle modes are excluded.

(2) For gasoline-fuel engines use:

$$BSFC = \frac{M_f}{BHP}$$

(3) For Diesel engines use:

$$CBSFC = \frac{M_f}{CBHP}$$

where:

$$CBHP = BHP\left[\frac{29.00}{EIP}\right]\left[\frac{T+459.69}{85+459.69}\right]^{0.7}$$

(4) Other methods of correcting power to determine *BSFC* may be used only with prior approval of the Administrator.

(k) Calculate the weighted brake-specific fuel consumption (*WBSFC*) for

(1) each gasoline engine test cycle by:

$$WBSFC(t) = \frac{\Sigma \text{ weighted } M_f}{\Sigma \text{ weighted } BHP}$$

where:

t=Test cycle number (t=1,2)

(2) each Diesel engine test by:

$$WCBSFC = \frac{\Sigma \text{ weighted } M_f}{\Sigma \text{ weighted } CBHP}$$

(l) For gasoline-fueled engines, calculate the brake-specific emissions and fuel consumption for the complete test as follows:

$$BSHC(T) = 0.35\ BSHC(1) + 0.65\ BSHC(2)$$
$$BSCO(T) = 0.35\ BSCO(1) + 0.65\ BSCO(2)$$
$$BSNO_x(T) = 0.35\ \ BSNO_x(1) + 0.65\ \ BSNO_x(2)$$
$$WBSFC(T) = 0.35\ WBSFC(1) + 0.65\ WBSFC(2)$$

§ 86.346–79 Alternative NO_x measurement technique.

(a) Oxides of nitrogen (NO_x) may be measured with the following "alternative instrumentation" for both Diesel and gasoline-fueled engines. The "alternative instrumentation" shall consist of:

(1) A heated sample line maintained above the dew point;

(2) An NO_x to NO converter obtaining a sample directly from the heated sample line; and

(3) A combination per 40 CFR 86.777 or 40 CFR 86.977, whichever is applicable, of a water trap, dryer, flow controls, and an NO NDIR analyzer obtaining a sample from the converter.

(b) The provisions of 40 CFR 86 Subpart D shall apply to the "alternative instrumentation", where applicable, with the following exceptions:

(1) Analyzer specifications found in §§ 86.315, 86.321, and 86.322 do not apply to the "alternative instrumentation".

(2) For the purposes of this section, the full-scale value specified in § 86.338 (a) (1) shall be 1,500 ppm for Diesel engines and 2,500 ppm for gasoline-fueled engines.

(c) The "alternative instrumentation" shall be calibrated per § 86.330.

(d) The NO NDIR analyzer shall meet the performance and interference specifications contained in 40 CFR 86.777 or 40 CFR 86.977, whichever is applicable.

(e) The operation of the dryer shall follow good engineering practice such that the test results are not altered. Proper preconditioning of the dryer is allowed.

§ 86.347–79 Alternative calculations for Diesel engines.

(a) This section applies to Diesel engines only. Gasoline-fueled engines must use the calculations in § 86.345.

(b) For Diesel engines, the calculations specified in 40 CFR 86.977–15 may be substituted for § 86.345.

(c) The modal *BSFC* and weighted *BSFC* shall be calculated per § 86.345.

(d) If the provisions of this section are used, a CO_2 measurement is not required.

(e) Both 40 CFR 86.977–15(a) and § 86.313 shall apply to air-flow measurements. For the purposes of this section, the air-flow measurement accuracy specified in § 86.313 shall be ±1 percent.

17. The title to Subpart H is revised to read as follows:

Subpart H—Emission Regulations for New 1977 and 1978 Model Year Gasoline-Fueled Heavy-Duty Engines; Test Procedures

18. Section 86.777–1 is revised to read as follows:

§ 86.777–1 General applicability.

The provisions of this subpart apply to new 1977 and 1978 model year gasoline-fueled heavy-duty engines.

19. New §§ 86.879–5 through 86.879–14 are added to Subpart I and read as follows:

§ 86.879–5 Test procedures.

The procedures described in this and subsequent sections will be the test program to determine the conformity of engines with the standard set forth in § 86.079–11(a).

(a) The test consists of a prescribed sequence of engine operating conditions on an engine dynamometer with continuous examination of the exhaust gases. The test is applicable equally to controlled engines equipped with means for preventing, controlling, or eliminating smoke emissions and to uncontrolled engines.

(b) The test is designed to determine the opacity of smoke in exhaust emissions during those engine operating conditions which tend to promote smoke from Diesel vehicles.

(c) The test procedure begins with a preconditioned engine which is then run through preloading and preconditioning operations. After an idling period, the engine is operated through acceleration and lugging modes during which smoke emission measurements are made to compare with the standards. The engine is then returned to the idle condition and the acceleration and lugging modes are repeated. Three consecutive sequences of acceleration and lugging constitutes the full set of operating conditions for smoke emission measurement.

(d) Except in cases of component malfunction or failure, all emission control systems installed on or incorporated in a new motor vehicle engine shall be functioning during all procedures in this subpart. Maintenance to correct component malfunction or failure shall be authorized in accordance with § 86.079–24.

§ 86.879–6 Diesel fuel specifications.

The requirements of this section are set forth in § 86.307.

§ 86.879–7 Dynamometer operation cycle for smoke emission tests.

(a) The following sequence of operations shall be performed during engine dynamometer testing of smoke emissions, starting with the dynamometer preloading determined and the engine preconditioned (§ 86.879–12(c)).

(1) *Idle mode.* The engine is caused to idle for 5 to 5.5 minutes at the manufacturer's recommended curb-idle speed. The dynamometer controls shall be set to provide minimum load by turning the load switch to the "off" position or by adjusting the controls to the minimum load position.

(2) *Acceleration mode.* (i) The engine speed shall be increased to 200±50 rpm above the manufacturer's recommended curb-idle speed within 3 seconds.

(ii) Immediately upon completion of the mode specified in paragraph (a) (2) (i) of this section, the throttle shall be moved rapidly to, and held in, the fully-open position. The inertia of the engine and the dynamometer, or alternately a preselected dynamometer load, shall be used to control the acceleration of the engine so that the speed increases to 85

percent of the rated speed in 5±1.5 seconds. This acceleration shall be linear within 100 rpm as specified in § 86.879–13(c).

(iii) After the engine reaches the speed required in paragraph (a)(2)(ii) of this section, the throttle shall be moved rapidly to, and held in, the fully-closed position. Immediately after the throttle is closed, the preselected load required to perform the acceleration in paragraph (a)(2)(iv) of this section shall be applied.

(iv) When the engine decelerates to the intermediate speed (within 50 rpm), the throttle shall be moved rapidly to, and held in, the fully-open position. The preselected dynamometer load which was applied during the preceding transition period shall be used to control the acceleration of the engine so that the speed increases to at least 95 percent of the rated speed in 10±2 seconds.

(3) *Lugging mode.* (i) Immediately upon completion of the preceding acceleration mode, the dynamometer controls shall be adjusted to permit the engine to develop maximum horsepower at rated speed. This transition period shall be 50 to 60 seconds in duration. During the last 10 seconds of this period, the engine speed shall be maintained within 50 rpm of the rated speed, and the power (corrected, if necessary, to rating conditions) shall be no less than 95 percent of the maximum horsepower developed at the zero-hour point.

(ii) With the throttle remaining in the fully-open position, the dynamometer controls shall be adjusted gradually so that the engine speed is reduced to the intermediate speed (within 50 rpm). This lugging operation shall be performed smoothly over a period of 35±5 seconds. The rate of slowing of the engine shall be linear, within 100 rpm, as specified in § 86.879–13(c).

(4) *Engine unloading.* Immediately upon completion of the preceding lugging mode, the dynamometer and engine controls shall be returned to the idle position described in paragraph (a)(1) of this section. The engine must be at the curb-idle condition within one minute after completion of the lugging mode.

(b) The procedures described in paragraphs (a)(1) through (a)(4) of this section shall be repeated until 3 consecutive valid cycles have been completed. If 3 valid cycles have not been completed after a total of 6 consecutive cycles have been run, the engine shall be preconditioned by operation at maximum horsepower at rated speed for 10 minutes before the test sequence is repeated.

§ 86.879–8 Dynamometer and engine equipment.

The following equipment shall be used for smoke emission testing of engines on engine dynamometers.

(a) An engine dynamometer with adequate characteristics to perform the test cycle described in § 86.879–7.

(b) An engine cooling system having sufficient capacity to maintain the engine at normal operating temperatures during conduct of the prescribed engine tests.

(c) A noninsulated exhaust system extending 15±5 feet from the exhaust manifold, or the crossover junction in the case of Vee engines, and presenting an exhaust back pressure within ±0.2 inch Hg of the upper limit at maximum rated horsepower, as established by the engine manufacturer in his sales and service literature for vehicle application. A conventional automotive muffler of a size and type commonly used with the engine being tested shall be employed in the exhaust system during smoke emission testing. The terminal 2 feet of the exhaust pipe shall be circular cross section and be free of elbows and bends. The end of the pipe shall be cut off squarely. The terminal 2 feet of the exhaust pipe shall have a nominal inside diameter in accordance with the engine being tested, as specified below:

Maximum rated horsepower:	*Exhaust pipe inside diameter*
Less than 101	inches... 3
101–200	do.... 3
201–300	do.... 4
301 or more	do.... 5

(d) An engine air inlet system presenting an air inlet restriction within 1 inch of water of the upper limit for the engine operating condition which results in maximum air flow, as established by the engine manufacturer in his sales and service literature, for the engine being tested.

§ 86.879–9 Smoke measurement system.

(a) *Schematic drawing.* The Figure I79–1 is a schematic drawing of the optical system of the light extinction meter.

(b) *Equipment.* The following equipment shall be used in the system:

(1) Adapter—the smokemeter optical unit may be mounted on a fixed or movable frame. The normal unrestricted shape of the exhaust plume shall not be modified by the adaptor, the meter, or any ventilator system used to remove the exhaust from the test site.

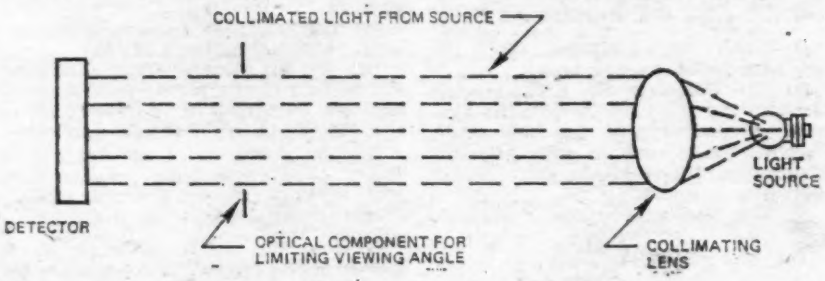

Figure I79-1 SMOKEMETER OPTICAL SYSTEM (SCHEMATIC)

(2) Smokemeter (light extinction meter)—continuous recording, full-flow light obscuration meter. It shall be positioned near the end of the exhaust pipe so that a built-in light beam traverses the exhaust smoke plume which issues from the pipe at right angles to the axis of the plume. The light source is an incandescent lamp operated at a constant voltage of not less than 15 percent of the manufacturer's specified voltage. The lamp output is collimated to a beam with a nominal diameter of 1.125 inches. The angle of divergence of the collimated beam shall be within 4° included angle. A light detector, directly opposed to the light source, measures the amount of light blocked by the smoke in the exhaust. The detector sensitivity is restricted to the visual range and comparable to that of the human eye. A collimating tube with apertures equal to the beam diameter is attached to the detector. It restricts the viewing angle of the detector to within 16° included angle. An amplified signal corresponding to the amount of light blocked is recorded continuously on a remote recorder. An air curtain across the light source and detector window assemblies may be used to minimize deposition of smoke particles on those surfaces provided that it does not measurably affect the opacity of the plume. The meter consists of two units, an optical unit and a remote control unit. Light extinction meters employing substantially identical measurement principles and producing substantially equivalent results but which employ other electronic and optical techniques may be used only after having been approved in advance by the Administrator.

(3) Recorder—a continuous recorder, with variable chart speed over a minimal range of 0.5 to 8.0 inch per minute (or equivalent) and an automatic marker indicating 1-second intervals shall be used for continuously recording the exhaust gas opacity, engine rpm and throttle position. The recorder shall be equipped to indicate only when the throttle is in the fully-open or fully-closed position. The recorder scale for opacity shall be linear and calibrated to read from 0 to 100 percent opacity full scale. The opacity trace shall have a resolution within 1-percent opacity. The recorder scale for engine rpm shall be linear and have a resolution of 30 rpm. The throttle position trace must clearly indicate when the throttle

is in the fully-open and fully-closed positions. Any means other than a strip-chart recorder may be used provided it produces a permanent visual data record of quality equal to or better than that described above.

(4) The recorder used with the smokemeter shall be capable of full-scale deflection in 0.5 second or less. The smokemeter-recorder combination may be damped so that signals with a frequency higher than 10 cycles per second are attenuated. A separate low-pass electronic filter with the following performance characteristics may be installed between the smokemeter and the recorder to achieve the high-frequency attenuation.

(i) 3 decibel point—10 cycles per second.

(ii) Insertion loss—zero ± 0.5 decible.

(iii) Selectivity—12 decibles per octave above 10 cycles per second.

(iv) Attenuation—27 decibels down at 40 cycles per second minimum.

(c) *Assembling equipment.* (1) The optical unit of the smokemeter shall be mounted radially to the exhaust pipe so that the measurement will be made at right angles to the axis of the exhaust plume. The distance from the optical centerline to the exhaust pipe outlet shall be 5±1 inch. The full flow of the exhaust stream shall be centered between the source and detector apertures (or windows and lenses) and on the axis of the light beam.

(2) Power shall be supplied to the control unit of the smokemeter in time to allow at least 15 minutes for stabilization prior to testing.

§ 86.879–10 Information.

The following information, as applicable, shall be recorded for each test:

(a) Engine description and specifications. A copy of the information specified in this paragraph must accompany each engine sent to the Administrator for compliance testing. If the engine is submitted to the Administrator for testing under Subpart D, only the information specified in § 86.337 need accompany the engine. The manufacturer need not record the information specified in this paragraph for each test if the information, with the exception of subparagraphs (3), (12), and (13) of this paragraph, is included in the manufacturer's Part I.

(1) Engine-system combination.

(2) Engine identification numbers.

(3) Number of hours of operation accumulated on engine.

(4) Rated maximum horsepower and torque.

(5) Maximum horsepower and torque speeds.

(6) Engine displacement.

(7) Governed speed.

(8) Curb-idle rpm.

(9) Fuel consumption at maximum power and torque.

(10) Maximum air flow.

(11) Air inlet restriction.

(12) Exhaust pipe diameter(s).

(13) Maximum exhaust system back pressure.

(b) Test data; general. This information may be recorded at any time between 4 hours prior to the test and 4 hours after the test.

(1) Engine-system combination.

(2) Engine identification numbers.

(3) Instrument operator.

(4) Engine operator.

(5) Number of hours of operation accumulated on the engine prior to beginning the warm-up portion of the test.

(6) Calibration date(s) of neutral density filters used to calibrate the smokemeter.

(c) Test data; pre-test.

(1) Date and time of day.

(2) Test number.

(3) Barometric pressure.

(4) Smokemeter: Number-zero control setting—calibration control setting—gain.

(5) Intake air humidity and temperature:

(i) Humidity-conditioned air supply. Air that has had its absolute humidity altered is considered humidity-conditioned air. For this type of intake air supply, the humidity measurement must be made within the intake air supply system, and after the humidity conditioning has taken place.

(ii) Non-conditioned air supply. Humidity measurements in non-conditioned intake air supply systems must be made in the intake air stream entering the supply system and within 18 inches of the inlet for supply system. Alternatively, the humidity measurements can be measured within the intake air supply stream.

(iii) Engine intake air temperature measurement must be made within 48 inches of the engine. The measurement location must be made either in the supply system or in the air stream entering the supply system.

(d) Test data; modal.

(1) Observed engine torque and speed during the steady-state test conditions specified in § 86.879–7(a)(3)(i).

(2) Recorder chart: Identify zero traces—calibration traces—idle traces—closed-throttle trace—open-throttle trace—acceleration and lugdown test traces—start and finish of each test.

§ 86.879–11 Instrument checks.

(a) The smokemeter shall be checked according to the following procedure prior to each test:

(1) The optical surfaces of the optical section shall be visually checked to verify that they are clean and free of foreign material and fingerprints;

(2) The zero control shall be adjusted under conditions of "no smoke" to give a recorder trace of zero;

(3) Calibrated neutral density filters having approximately 10, 20, and 40 percent opacity shall be employed to check the linearity of the instrument. The filter(s) shall be inserted in the light path perpendicular to the axis of the beam and adjacent to the opening from which the beam of light from the light source emanates, and the recorder response shall be noted. The nominal opacity value of the filter shall be confirmed by the Administrator semi-annually. Deviations in excess of 1 percent of the nominal opacity shall be corrected.

(b) The instruments for measuring and recording engine rpm, engine torque, air inlet restrictions, exhaust system back pressure, throttle position, etc., which are used in the tests prescribed herein, shall be calibrated in accordance with good engineering practice.

§ 86.879–12 Test run.

(a) The temperature of the air supplied to the engine shall be between 68° F and 86° F. The fuel temperature at the pump inlet shall be 100° F±10° F. The observed barometric pressure shall be between 28.5 inches and 31 inches Hg. Higher air temperature or lower barometric pressure may be used, if desired, but no allowance will be made for possible increased smoke emissions because of such conditions.

(b) The governor and fuel system shall have been adjusted to provide engine performance at the levels in the application for certification required under § 86.079–21.

(c) The following steps shall be taken for each test:

(1) Start cooling system;

(2) Warm-up the engine by the procedure described in § 86.341(d)(5);

(3) Determine by experimentation the dynamometer inertia and dynamometer load required to perform the acceleration in the dynamometer cycle for smoke emission tests (§ 86.879–7(a)(2)). In a manner appropriate for the dynamometer and controls being used, arrange to conduct the acceleration mode;

(4) Install smokemeter optical unit and connect it to the recorder. Connect the engine rpm and throttle position sensing devices to the recorder;

(5) Turn on purge air to the optical unit of the smokemeter, if purge air is used;

(6) Check and record zero and span settings of the smokemeter recorder at a chart speed of approximately 1 inch per minute. (The optical unit shall be retracted from its position about the exhaust stream if the engine is left running.);

(7) Precondition the engine by operating it for 10 minutes at maximum rated horsepower;

(8) Proceed with the sequence of smoke emission measurements on the engine dynamometer as prescribed in § 86.879–7;

(9) During the test sequence of § 86.879–7, continuously record smoke measurements, engine rpm, and throttle position at a minimum chart speed of 1 inch per minute during the idle mode and transitional periods and 8 inches per minute during the acceleration and lugging modes. The smokemeter zero and full-scale recorder deflections may be rechecked during the idle mode of each test sequence. If either zero or full-scale drift is in excess of 2 percent opacity, the smokemeter controls must be readjusted and the test must be repeated;

(10) Turn off engine;

(11) Check zero and reset if necessary and check span of the smokemeter recorder by inserting neutral density filters. If either zero or span drift is in excess of 2 percent opacity, the test results shall be invalidated.

§ 86.879–13 Chart reading.

The following procedure shall be used to analyze the recorder chart:

(a) Locate the modes specified in § 86.879–7 (a) (1) through (a) (4) by applying the following starting and ending criteria:

(1) The idle mode specified in § 86.879–7(a) (1) starts when engine preconditioning or the lugging mode of a preceding cycle has been completed and ends when the engine speed is raised above the idle speed.

(2) The acceleration mode specified in § 86.879–7(a) (2) (i) starts when the preceding idle mode has been completed and ends when the throttle is in the fully-open position as indicated by the throttle position trace.

(3) The acceleration mode specified in § 86.879–7(a) (2) (ii) starts when the preceding acceleration mode has been completed and ends when the engine speed reaches 85 percent of the rated speed.

(4) The transition period specified in § 86.879–7(a) (2) (iii) starts when the preceding acceleration mode has been completed and ends when the throttle is in the fully-open position as indicated by the throttle position trace.

(5) The acceleration mode specified in § 86.879–7(a) (2) (iv) starts when the preceding transition period has been completed and ends when the engine speed reaches 95 percent of the rated speed.

(6) The transition period specified in § 86.879–7(a) (3) (i) starts when the preceding acceleration mode has been completed and ends when the engine speed is 50 rpm below the rated speed and the provisions of § 86.879–7(a) (3) (i) are met.

(7) The lugging mode specified in § 86.879–7(a) (3) (ii) starts when the preceding transition period has been completed and ends when the engine speed is at the intermediate speed.

(b) Determine if the test requirements of § 86.879–7 are met by applying the following modal criteria:

(1) Idle mode as specified in § 86.879–7 (a) (1):

(i) Duration: 5 to 5.5 minutes.

(ii) Speed: Within specifications during the last 4 minutes of the mode.

(2) Acceleration mode as specified in § 86.879–7(a) (2) (i).

(i) Duration: 3 seconds or less.

(ii) Speed increase: 200±50 rpm.

(3) Acceleration made as specified in § 86.879–7(a) (2) (ii):

(i) Linearity: ±100 rpm as specified in paragraph (c) of this section.

(ii) Duration: 3.5 to 6.5 seconds.

(iii) Throttle position: Fully-open until speed is at least 95 percent of the rated speed.

(4) Transition period as specified in § 86.879–7(a) (2) (iii):

(i) Throttle position: Moved rapidly to, and held in the fully-closed position.

(5) Acceleration mode as specified in § 86.879–7(a) (2) (iv):

(i) Duration: 8 to 12 seconds.

(ii) Throttle position: Fully-open when speed is at intermediate speed.

(6) Transition period as specified in § 86.879–7(a) (3) (i):

(i) Duration: 50 to 60 seconds.

(ii) Speed during last 10 seconds within ±50 rpm of rated speed.

(iii) Corrected power during last 10 seconds: At least 95 percent of horsepower developed during zero-hour testing.

(7) Lugging mode as specified in § 86.879–7 (a) (3) (ii):

(i) Linearity: ±100 rpm as specified in paragraph (c) of this section.

(ii) Duration: 30 to 40 seconds.

(iii) Speed at end: Intermediate speed.

(c) Determine if the linearity requirements of § 86.879–7 were met by means of the following procedure:

(1) For the acceleration mode specified in § 86.879–7(a) (2) (ii), note the maximum deflection of the rpm trace from a straight line drawn between the starting and ending points specified in paragraph (a) (3) of this section.

(2) For the lugging mode specified in § 86.879–7(a) (3) (ii), note the maximum deflection of the rpm trace from a straight line drawn from the starting and ending points specified in paragraph (a) (7) of this section.

(3) The test results will be invalid if any deflection is greater than 100 rpm.

(d) Analyze the smoke trace by means of the following procedure:

(1) Starting at the beginning of the first acceleration, as defined in paragraph (a) (2) of this section, and stopping at the end of the second acceleration, as defined in paragraph (a) (3) of this section, divide the smoke trace into ½-second intervals. Similarly, subdivide into ½-second intervals the third acceleration mode and the lugging mode as defined by paragraphs (a) (5) and (7) respectively, of this section.

(2) Determine the average smoke reading during each ½-second interval.

(3) Locate and record the 15 highest ½-second readings during the acceleration mode of each dynamometer cycle.

(4) Locate and record the five highest ½-second readings during the lugging mode of each dynamometer cycle.

(5) Examine the average ½-second values which were determined in subparagraphs (3) and (4) of this paragraph and record the 3 highest values for each dynamometer cycle.

§ 86.879–14 Calculations.

(a) Average the 45 readings in § 86.879–13(d) (3) and designate the value as "A".

(b) Average the 15 readings in § 86.879–13(d) (4) and designate the value as "B".

(c) Average the 9 readings in § 86.879–13(d) (5) and designate the value as "C".

20. The title to Subpart J is revised to read as follows:

Subpart J—Emission Regulations for New 1977 and 1978 Model Year Diesel Heavy-Duty Engines; Gaseous Exhaust Test Procedure

21. Section 86.977–1 is revised to read as follows:

§ 86.977–1 General applicability.

The provisions of this subpart apply to new 1977 and 1978 model year Diesel heavy-duty engines.

(Secs. 202, 206, 207, 208, 301(a), Clean Air Act, as amended (42 U.S.C. 7521, 7525, 7541, 7542, 7601, formerly 42 U.S.C. 1857f–1, 1857f–5, 1857f–5a, 1857f–6, 1877g(a) which was reclassified by 91 Stat. 685 (August 7, 1977)).)

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